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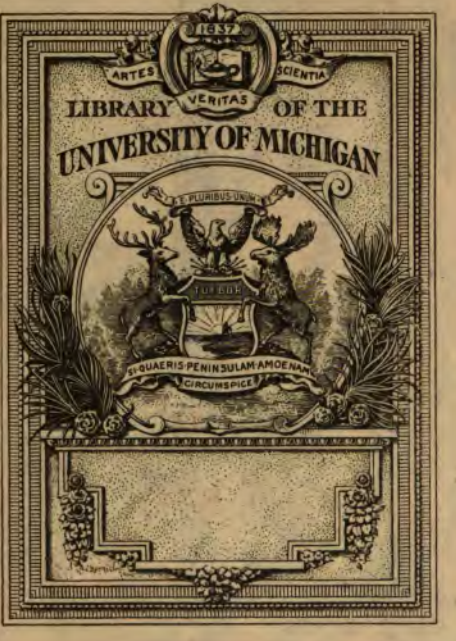
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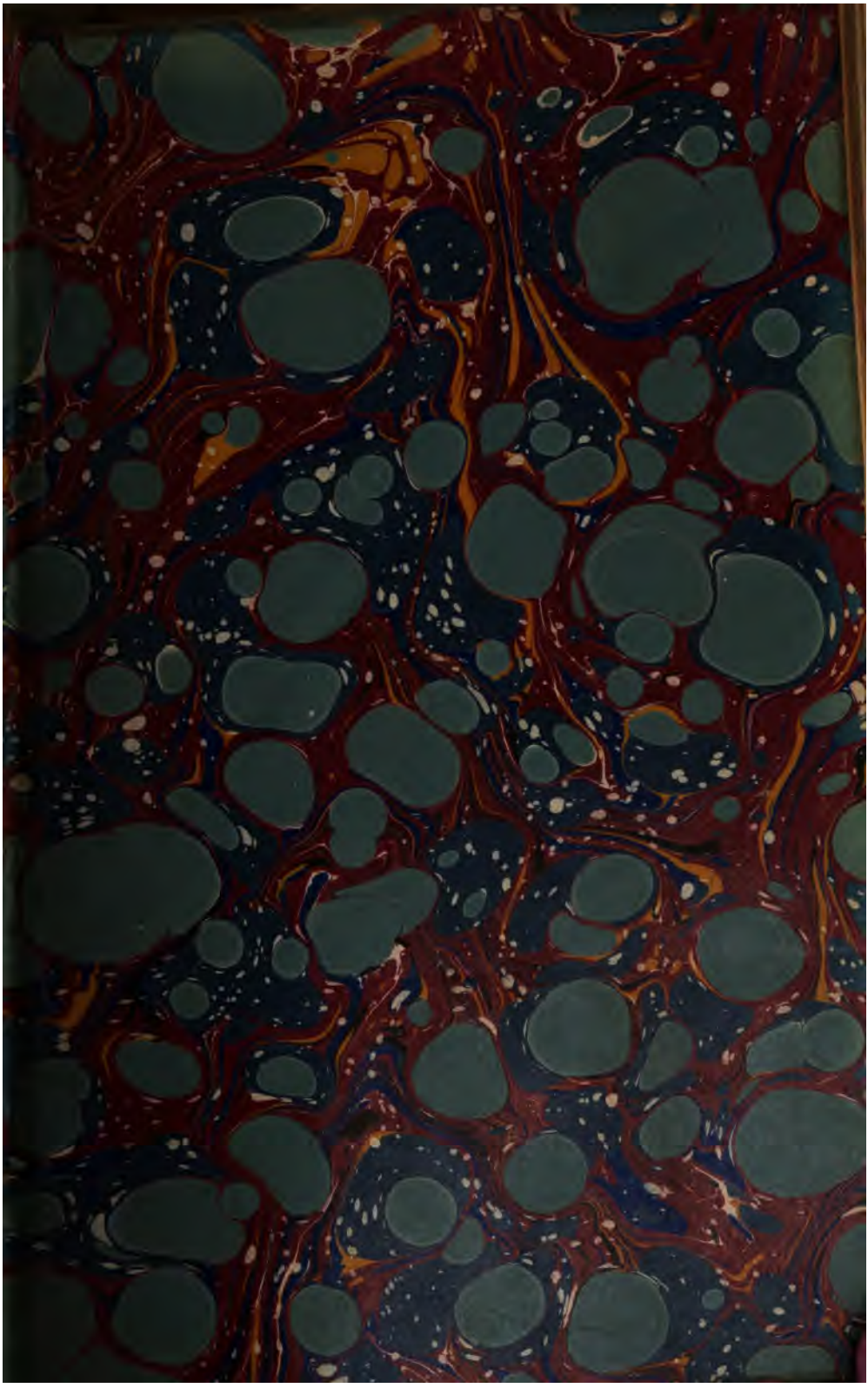

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The Astronomical Register.

No. 193. JANUARY. 1879.

THE ASTRONOMICAL REGISTER.

Subscribers will notice some alterations in this the first number of our Seventeenth Volume, which we trust they will generally consider to be improvements. The budget of correspondence, which has yearly grown in interest and importance, will for the future be printed in larger sized type. The ephemerides will, after the present month, contain fuller information with regard to the periods of variable stars and other matters of interest to observers.

The Reports of the Meetings of the Royal Astronomical Society, which for three or four years past have been submitted in proof to the speakers for correction, will be prepared with the care which has hitherto been bestowed upon them; and since some of the most distinguished public speakers acknowledge that they make their best speeches on the way home from the meetings at which the speeches should have been delivered, we shall continue to invite those who have taken part in the meetings of the Society to supply any additional information they may desire to give in the form of notes to the subject matter of the shorthand writer's reports. On turning over past numbers of the *Register* it will be seen that many of the notes which have thus been contributed contain very valuable information which would otherwise have been lost.

We shall endeavour in the general conduct of the magazine to

abstain from party bias, and to keep our pages freely open to fair discussion, in parliamentary language, of any matters connected with astronomy which are likely to interest our readers.

EDITOR.

CLASSIFICATION OF DOUBLE STARS.

Communicated by M. CAMILLE FLAMMARION.

Double stars form a very important branch of sidereal astronomy, the most important perhaps; nevertheless no comprehensive work has yet been devoted to them. In the course of the year 1873, wishing to inform myself of the nature of these systems, I was, to my great surprise, immediately arrested by the complete want of satisfactory documents. How many double or multiple stars are known at present? What is their proportion to single stars? In the total number of groups discovered, which are merely optical, due to the chances of perspective, and which are real, formed by several stars associated together? Amongst the real or physical groups, how many show, by the relative displacement of the component stars, the action of gravitation in those distant systems? Which are the pairs in sure orbital movement? Which are those whose orbital movement is probable? and are there also some whose movement is not orbital? By what proper motions are those systems carried through space? Can some law be discovered in their distribution as well as in their courses, and in the relative brilliancy of the components and their striking combinations of colours? There was only one way of replying to these and many other questions, which was resolutely to undertake the examination in detail of every one of the eleven thousand double stars that have been discovered, to compare all the observations made (more than two hundred thousand; angles of positions and distances), to deduce the conclusion furnished by that examination for each pair; then to make a list of the pairs whose components have remained fixed with respect to each other, and to distinguish in this list those which are carried along in space by a common proper motion; finally, to bring together the pairs which are in motion, to discuss the doubtful ones, to measure the neglected pairs, to form a catalogue of the stars in sure relative movement, identify them, examine their proper motions, analyse the observed variations, and find definitely which are the *physical systems in orbital movement*, and which are the *optical groups* due

to the meeting on the same visual ray of two stars possessed of different proper motions. This is what I have done.*

These researches have led me to the following conclusions: Of the 11,000 known double or multiple stars, not more than 819 afford certain evidence of a relative motion of the components. These 819 groups divide themselves into 731 doubles, 73 triples, 12 quadruples, two quintuples, and one sextuple, in all 1745 stars variously associated. They have been the object of about 28,000 measurements, angles of positions and distances, all of which I have compared together.

Of the pairs in motion, I have found 558 which form orbital systems, 316 whose components are merely united by the chance of celestial perspective, and form optical groups. There are 17 physical systems whose components change their places in a straight line, 23 ternary systems, 32 triple stars not ternary, formed of a binary system, and an optical companion, five quarternary systems. I have also been able to collect 14 stellar systems of more than one minute distance, and 85 physical pairs less than one minute, whose components have a common proper motion in space, but are fixed in relation to one another.

According to the observations, the angular distance of the two components of an orbital system may amount to 22 seconds of arc; stars separated by as much as 15 minutes may have a common proper motion, and the temporary components of a perspective group have sometimes approached each other as near as two seconds; the greatest annual velocity observed in the relative motions of perspective groups has amounted to $4''{\cdot}10$. In the orbital systems, there is observed a preponderance of revolving in the retrograde direction, from north to south by the west: 280 revolve in this way, 248 have direct revolution, 30 gravitate in a plane passing through the sun.

The comparison of measurements shows that the calculations of the orbits cannot be as rigorous as many astronomers have imagined. The orbital systems which have gone through the greatest angle are the following:

* Many pairs have been the object of very numerous observations, some of as many as 300. The finest have been noticed more than 200 years, such as ζ of the Great Bear since 1650, γ of the Ram since 1664, α of the Centaur since 1689; γ of the Virgin has been measured since 1718, Castor since 1719, &c. On the other hand some other stars have but little attracted the attention of astronomers, and it has been necessary to examine publications of the observatories of both hemispheres to glean with great difficulty some rare and often discordant measurements. But, by a fortunate coincidence, the principal pairs were measured just a century ago by Mayer and Herschel. The conclusions published up to this time about the proportion of the number of the optical pairs and the physical pairs are quite erroneous, since motion has often been wrongly taken as proof of the reality of the pairs.

A.—Those which have accomplished one or more revolutions since their discovery.

Stars.	Magnitudes.	Colours.	Semi-axis major.	Calculated period.	Years of observ.	Direction of movement.
			"			
δ Equulei	4, 5—5, 0	white	0.40	7 or 14 years	25	P
3130 Σ (365) Σ_2 Lyræ	7, 4—11	white	0,25	16	37	P
42 Comæ Berenicis	6, 0=6, 0	white	0,50	25y.,49	50	P
ζ Herculis	3, 0—6, 5	yellow and reddish	1,36	34,58	95	R
3121 Σ Cancri	7, 2—7, 5	white and yellow	0,50	39,18	45	P
η Coronæ Borealis	5, 5—6, 0	golden yellow	0,98	40,17	96	D
2173 Σ, Ophiuchi	6, 0=6, 0	yellow	1,01	45,43	48	P
γ Coronæ Australis	5, 5=5, 5	golden yellow	2,40	55,58	42	R
ζ Cancri A B	5, 5—6, 2	yellow	0,91	60,45	95	R
ξ Ursæ Majoris	4, 0—5, 0	yellow & ash colour	2,50	60,63	96	R
α Centauri	1, 0—2, 0	white and yellow	21,80	85,04	169	D
70 Ophiuchi	4, 5—6, 6	yellow & rose colour	4,88	94.93	98	R
ξ Scorpii A B	5, 0—5, 2	yellow	1,26	95,90	95	D

B.—Those which have accomplished more than three-quarters of a revolution: 270° to 360°.

Stars.	Magnitudes.	Colours.	Arc accomplished.	Semi-axis major.	Calculated period.	Years of observ.	Direction of movement.
			°	"			
3062 Σ Cassiopeiæ	6, 5—7, 5	yellow and olive	338	1,27	104 years	95	D
ω Leonis	6, 2—7, 0	yellow	326	0,89	111	95	D
25 Canum Venat.	5, 7—7, 6	white and blue	281	0,65	124	50	P
γ Virginis	3, 0=3, 0	yellow	352	3,38	175	159	R
τ Ophiuchi	5, 0—6, 0	white	279	1,10	218	94	D

C.—Those which have accomplished more than a half revolution: 180° to 270°.

Stars.	Magnitudes.	Colours.	Arc accomplished.	Mean distance.	Time for 360°.	Years of observ.	Direction of movement.
			°	"			
8 Sextantis A C	5, 6—6, 5	white	260	0'4	33 years	24	R
μ^2 Boötis	6, 5—7, 5	white	226	1,47	280	96	R
σ, Coronæ Borealis	5, 8—6, 5	yellow and greenish	214	2,5	846	96	D
(89) Σ_2 Camelopardi	6, 2—7, 6	white	209	0,4	52	30	D
(527) Σ_2 Equulei	7, 0—8, 0	bluish and white	207	0,4	54	31	R
o^2 Eridani B C	9, 5—10, 5	yellow	196	4,0	200	94	R
(234) Σ_2 Ursæ Major.	7, 0—7, 8	white	187	0,3	68	35	D
4 Aquarii	6, 0—7, 0	yellow	184	0,4	184	94	D
γ Coronæ Borealis	4, 0—7, 0	yellow and purple	plane	0,70	95	52	P
316 Σ 2 Cephei	6, 3—6, 5	yellow and green	>180	0,5	?	48	R

D.—Those which have accomplished more than a quarter of a revolution: 90° to 180°.

Stars.	Magnitudes.	Colours.	Arc accomplished.	Mean distance.	Time for 360°.	Years of observ.	Direction of movement.
			°	″			
μ Herculis B C	9, 4—10	blue	174	1,0	43 years	21	P
2120 Σ, Herculis	7, 0—9, 0	yellow and blue	146	3,0	232	94	R
(235) Σ_2 Ursæ Major.	6, 0—7, 8	white	132	0,7	90	34	D
(298) Σ_2 Boötis	7, 0—7, 4	white	130	1,0	97	35	D
(251) Σ_2 Comæ Beren.	7, 4—9, 1	white	127	0,3	—	32	D
Castor A B	2, 5—2, 8	white	121	5,0	1000	158	R
387 Σ_2 Cygni	7, 5—8, 0	white	112	0,4	108	33	R
ϕ Ursæ Majoris	5, 0—5, 5	white	111	0,3	100	33	D
λ Ophiuchi	4, 0—6, 0	white and ash colour	110	1,2	300	94	D
p Eridani	6, 0=6, 0	white	106	4,0	200	52	R
ξ Boötis	4, 5—6, 5	yellow and red	101	4,9	127	95	R
δ Cygni	3, 0—8, 0	white and blue	101	1,7	336	94	R
44 i Boötis	5, 3—6, 0	white and ash colour	plane	3,1	261	96	P
η Cassiopeiæ	4, 0—7, 6	yellow and purple	90	9,0	384	96	D

ROYAL ASTRONOMICAL SOCIETY.

Session 1878—79.

Second Meeting after the Long Vacation, December 13th, 1878.

Lord Lindsay, M.P., F.R.S., &c., *President*, in the Chair.

Secretaries—Mr. Glaisher and Mr. Ranyard.

The minutes of the preceding meeting were read and confirmed,

The Rev. C. Heaven, of the Orchards, Stone, Aylesbury, Bucks.

James Whewell, Esq., of Savile House Observatory, Halifax, were balloted for and duly elected Fellows of the Society.

Mr. Ranyard said: I have received a letter from Prof. Eastman, an extract from which I will read. Prof. Eastman observed at the same station as Mr. Schuster. His telescope was an equatorial of three inches aperture, carrying a spectroscope which was pointed by an assistant, who was observing with the finder. "In the field of the finder was a *pointer*, the length of which was almost exactly equal to the diameter of the moon. The slit was adjusted so as to be tangential to the north and south limbs of the sun, and the pointer was so adjusted that the portion of the sun covered by the end of the pointer was exactly on the centre of the slit. During the total phase the slit was placed on the corona close to the south limb of the moon, and after the slit was opened wide enough to show the green line 1474. It was then moved slowly outward, over the corona, until the 1474 line and the continuous spectrum suddenly disappeared together. The distance

of the end of the pointer from the moon's limb was then carefully estimated and recorded, and the observations repeated. Similar observations were made on the north, west, and east sections of the corona, but I did not *sweep* around the moon. The means of the two estimated distances in lunar diameters were, south 0·42di., west 0·40di., north 0·38di.. east 0·32di."

Mr. Ranyard said: This is an interesting observation, as it shows that the bright line area of the corona did not correspond with the bright rays and structure of the corona. It somewhat corresponds with the observation of Capt. Herschel, made in 1871, who saw the bright line 1474 extending into the area of the great southern rift, without any diminution of brightness. Prof. Eastman continues with the following remark, "the corona of this year was much more brilliant than that seen at Des Moines in 1869, or at Syracuse in 1870."

Mr. Christie was called upon to read a paper by the Astronomer-Royal. He said: The Astronomer-Royal desires to call attention to a remarkable conjunction of the planets Mars and Saturn, which will occur on the 30th June, 1879. He has prepared a diagram showing the positions of the two planets on the occasion. The places of the planets are deduced from the elements given in the *Nautical Almanac*. Mr. Dunkin has computed the geocentric centres of the planet for every quarter of an hour over a greater part of the time. On the chart will be seen the places at the time of the nearest approach, and the positions, the magnitude of the planets, and the positions of Saturn's rings are also represented as accurately as possible. The axis of the ring is slightly inclined northward to the equator. The nearest approach of the two planets will be at 7h. 30m., G.M.T., and the distance between them will be 1′ 12″. Local times are given for the Cape of Good Hope, Vienna, San Francisco, Cordoba, &c. These stations are selected as giving a chain of longitude, proceeding easterly round the earth. The closest proximity of the planets cannot be seen in Europe, but in Australia the conjunctions will be seen extremely well. But no part of the near approach can be seen in America. The instrumental measures of the relative positions of the planet will give a test of Le Verrier's tables, and therefore we may look with interest on the observations that may be made. At the conjunction of 1873 the distance between the planets rendered it impossible to see them both in the field of the telescope at once. On that occasion the Astronomer-Royal was struck with the fiery red colour of Mars, and the deep sap-green colour of Saturn. During the approaching conjunction Mars will be smaller, and the colours of the planets will therefore probably be compared more justly. Mars will apparently pass over some of the orbits of the satellites

of Saturn, and according to Mr. Marth will be within 30 seconds of Iapetus.

Mr. Christie also said: I have another note from the Astronomer-Royal *On the Mass of Mars.* He wishes to call attention to an investigation he made fifty years ago, which was published in the *Philosophical Transactions* for 1828. It was a discussion of ten-and-a-half years' observations at Greenwich. The result which the Astronomer-Royal obtained for the mass of Mars was $\frac{1}{3734609}$; a value which is smaller than Professor Asaph Hall's value, viz., $\frac{1}{3107713}$, but was not so far from it as Laplace's value, viz., $\frac{1}{3418052}$.

The President: I feel sure that the Society will return their thanks to the Astronomer-Royal for his interesting papers; we can only regret that he is unable to read them in person.

Mr. Neison asked whether the effect of parallax in Australia would be to bring Mars nearer to Saturn or farther off.

Mr. Marth: The parallax will be trifling. A greater effect will be produced by the errors in the *Nautical Almanac* ephemeris. The new tables for Saturn do not begin till 1880. At that time the error or the difference between the places from Le Verrier's tables and the *Nautical Almanac* tables amounts to something like 20″ in R.A. Saturn is thrown further to the left by the new tables. This effect is far larger than the effect of parallax. At the time of the conjunction Iapetus will be near its greatest western elongation, where it appears pretty bright, and Mars will pass between it and Saturn. But though the place of Iapetus is rather uncertain and Mars passes within 30″ of it, it seems that an occultation of the satellite is out of the question.

Mr. Dunkin: I think the tabular error of Saturn in R.A. at the present time is nearer 10″ than 20″. During the last opposition the error was about seven or eight-tenths of a second of time, and that would be from 10″ to 12″. The tabular errors of Saturn change very much during the season, and about the time of opposition the errors are large comparatively; but when Saturn comes nearer quadrature they are very much smaller; so that as Saturn at the time of the conjunction is near quadrature the tabular error most likely will be about 10″, and not 20″.

Mr. Marth: I have nothing to go by except the difference between the places given by Le Verrier's tables, and by those of Bouvard for Jan. 1, 1880, when, if I remember right, it amounts to 22″ in heliocentric longitude. I do not know how the errors run, and, of course, I assume that Le Verrier is right.*

* [Note by Mr. Marth.] The comparison of the *Nautical Almanac* places of Saturn for December 31, 1879 and January 1, 1880 shows, that the heliocentric position of Saturn, as derived from Bouvard's tables,

Mr. Gill: I have heard this paper with much interest, because when I was at Ascension I had the good fortune to observe, under circumstances which no one in Europe can meet with, the conjunction of Mars and Saturn. I observed with the heliometer for the two days preceding and following, as well as on the day of the conjunction; and while making measures I noticed the red and green colours mentioned by the Astronomer-Royal. When looked at with the whole object-glass, the contrast of brilliancy of the two planets was very remarkable, and in order to get satisfactory measures I was obliged to diminish the brilliancy of Mars by using a wire screen, otherwise it would have been too bright, compared with Saturn, to allow of accurate measures being made.

The President: Do you think that the green colour of Saturn was due to the contrast with the red of Mars?

Mr. Gill: Yes, in some degree. When I shut out the light of Mars I did not see the green colour brought out so clearly.

Mr. Neison: Mr. Gill determined, I think, what really was the heliocentric error of Mars; and, if I understand, it was $2\frac{1}{2}$ secs., whereas the parallax would be about 8 seconds. What I want to know is whether the effect of parallax will be to bring Mars nearer or farther off from Saturn than as shown on the diagram?

Mr. Christie: There was no attempt to give in this diagram

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requires for that day the corrections in long. + 22″·2. lat. — 11″·5, log. rad. v. — ·0000626, in order to agree with the position as derived from Le Verrier's tables. Assuming, in the absence of a direct calculation from the new tables and of any notion of the run of the errors, that the same corrections are also valid for the heliocentric place half a year earlier, the *Nautical Almanac* geocentric R. A. on June 30 requires a correction of + 27″·6, the Decl. of — 0″·8, the increased corr. of R. A. at the time of morning quadrature being due to the diminution of the radius vector. In a diagram of the conjunction shown among other diagrams of conjunctions on a former occasion, as reported in Vol. XV. p. 160, I contented myself with correcting the *Nautical Almanac* place of Saturn approximately by applying + 21″·6 in R. A. and — 3″·0 in Decl., the corrections of the geocentric place on Dec. 31. Adopting now + 27″·6 and — 0″·8 as the corrections, the rectangular co-ordinates of Mars in reference to Saturn, and also those of Iapetus, Titan and Rhea, as derived from approximate calculations, are the following:—

1879. June 30.

G.M.T.	Mars.	Iapetus.	Titan.	Rhea.
h.	″ ″	″ ″	″ ″	″ ″
2.	p. 529·6 s. 127·7	p. 501·6 s. 88·4	f. 67·0 s. 31·2	f. 11·8 n. 13·0
4.	„ 355·2 s. 56·1	„ 501·7 „ 89·2	„ 72·3 „ 31·1	„ 3·0 „ 13·5
6.	„ 180·7 n. 15·5	„ 501·8 „ 90·0	„ 77·5 „ 30·9	p. 5·8 „ 13·9
8.	„ 6·2 „ 87·1	„ 501·9 „ 90·7	„ 82·6 „ 30·7	„ 14·5 „ 14·0
10.	f. 160·3 s. 158·7	p. 501·9 s. 91·5	f. 87·8 s. 30·4	p. 23·1 n. 14·0

p. precedes, f. follows, n. north, s. south; the co-ordinates being referred to the circle of declination. Equat. diameter of Saturn 17″·1. Diam. of Mars 8″·8.

According to these data the nearest geocentric distance of the centres

any very accurate representation, or any minutiæ such as parallax. But I think Mr. Neison is under a misapprehension with regard to Mars and Saturn. The error of Mars is small because the place in the *Nautical Almanac* is taken from Le Verrier; but the error of Saturn may be considerable, and in the case of a conjunction you have to consider both errors. Mr. Gill determined the error of Mars. I am not prepared at this moment to say which way the parallax would act.

Mr. Dunkin: The effect of the parallax in the northern hemisphere would be to drive Mars downward.

Mr. Christie: The north is the top of the diagram.

Mr. Neison: That answers my question. If the diagram shows north at the top the distance in Australia would be increased, and we should have a less interesting result.

Mr. Christie: But in Australia there would be a considerable hour angle.

Mr. Dunkin: As far as the parallax is concerned, we are discussing a very small matter. In Australia, where this conjunction will be visible better than anywhere else, the parallax will be very small, because at the time of least distance the planets will be a fair height above the horizon, and the effect of parallax will not be more than 4″ or 5″.

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of Mars and Saturn will be 83″·0 at 7h. 43m. G. M. T. At Melbourne, where the conjunction can be observed in the morning, the nearest distance of the centres will be increased by parallax to 87″. If the *Nautical Almanac* place of Saturn were correct, the nearest geocentric distance would be 71″·7 at 7h. 26m. G. M. T.

The place of Iapetus is too uncertain to allow a proper prediction to be made. If the above data were correct, the nearest approach of the satellite to the limb of Mars would be 21″·2 at 2h. 26m. G. M. T., and parallax would lessen the distance for Tahiti.

The last close conjunction of Mars and Saturn occurred on April 18, 1817, but a strict calculation of their places from Le Verrier's tables would be required to determine the nearest distance. The planets were then some fifty degrees from the sun, and the conjunction could only have been observed in the morning in Australia or Eastern Asia.

There are fifty conjunctions between Mars and Saturn in a century, and from that observed by Walter on October 30, 1479 to that of June 30, 1879, there have been 200. Nine of these were threefold or triple, Mars first passing Saturn, then in its retrograde course repassing it, and again in its forward course overtaking it a third time during the same apparition. The years of some of these triple conjunctions were mentioned on p. 91 of Vol. XIV., but it may be of interest to some readers to have the whole list.

1503—04	1640	1745.
1505—06	1706—07	1779.
1542	1742—43	1877.

Conjunction of the last year being triple in right-ascension only, but not in longitude, as was explained on p. 157 of Vol. XV.

Mr. Gill was called upon to read a paper by Prof. Winnecke *On the visibility in the Pleiades to the naked eye.* Mr. Gill said Dr. Winnecke had lately been looking over some very old observations of the Pleiades and had found an observation made in the year 1580, giving the R. A. and declination as obtained by rough means. There were eleven stars given, which he reduces to the epoch of Bessel's observations, and compares the results. He finds that the places of the eleven stars observed were determined in 1580, with a probable error of only two minutes of arc; but the important point of the paper is that these observations were made before the invention of the telescope, and they confirm beyond all doubt a diagram which was published some time ago in the *Monthly Notices* by the Astronomer-Royal, representing the stars of the Pleiades as seen by one of his daughters. There can be no question that this astronomer, who never had a telescope, did see eleven stars, and was able to measure their places very approximately.

Mr. Gill read a paper *On Measures of the binary star α Centauri, made by him at Ascension Island in the latter half of the year* 1877. The measures were made with considerable difficulty on account of the brilliancy and closeness of the stars. Special methods of observation, which were described, were adopted. The results showed that during the period of observation (little more than four months) the distance had closed from about 2″·2 to 1″·6 or 1″·7, and the position angle which was about 80° had changed to about 100° at the end of the series of measures. Thus a change of about 0″·5 in distance and 20° in position angle took place in the short period of four months.

In connection with the measures it is interesting to hear from a letter of Mr. Ellery (*The Observatory*, August, 1878) that, from measures of α Centauri on May 8 of the present year, the components are now slowly separating. It appears then that these measures at Ascension were made during a very critical period in the orbit, and Mr. Gill hoped that they would be valuable.

Mr. Thornthwaite suggested that a cylindrical lens might be used in front of the eye-piece, so as to transform the image of the star into a bright line.

The President: I can speak from experience as to what Mr. Gill has said about the difficulties of measuring double stars with the heliometer. The ray of light perpendicular to the division of the object-glass is also apt at first to be troublesome. I think Mr. Gill will remember that, when we were at work one night, one of us thought he had discovered a comet. It was a cause of great excitement for some little time. But we soon traced the ray for some 20 degrees to the star Vega; the light of the star

had fallen on the division between the two segments of the object-glass, and it had been reflected down the telescope. It made a most excellent comet. (Laughter.)

Mr. Christie said: I have a short note *On a Phenomenon seen in the occultation of a star at the moon's bright limb.* As I have not come across any other description of this phenomenon, I thought it might be worthy of mention. I observed the occultation with the full aperture, nearly 13 inches, of the great equatorial at Greenwich, using a negative eye-piece with a power 310, and my eyes were dazzled by the intense light of the moon. The star was of the $4\frac{1}{2}$ magnitude, and as it approached the moon's limb I fixed my attention on it. I watched it coming slowly up to the limb and expected it to disappear, but to my surprise instead of disappearing in a slight notch in the limb, the moon's limb seemed to recede for 3 or 4 secs., and the star disappeared in a sort of luminous haze through which it was seen with more and more difficulty as it advanced. At the instant before disappearance the star was perfectly bisected by the limb and was completely shorn of its rays on the one side, but was intact on the other. This observation accords with the explanation of the phenomena by the Astronomer-Royal, as given in Vol. XXVIII. of the *Memoirs*, viz., "that the phenomenon of apparent projection of stars on the moon's disk is due to the irradiation caused by the diffraction image of the moon being larger than the moon." In this case the star was not so faint as to be overpowered by the irradiation of the limb. It is evident that the intensity of light would increase from the spurious limb to the true limb. For corresponding to each point of the moon's limb we should have a circle of light gradually decreasing in brightness outwards; this would form a fringe round the moon's limb, and if the star is very bright it will be seen projected on this spurious edge, so that one would be conscious of the limb behind the star. But if (as in this case) the star was so faint as to be nearly equal in intensity to the light of the spurious limb, it would require concentrated and close attention to see it upon the limb, and you would see it mixed up with the moon's light. That is the only explanation I can offer. I may mention that I saw the star as if it were bisected. On this evening when another of the Pleiades was occulted, I watched some of the occultations, and tried the effect of a dark wedge, which enabled me to observe the occultation perfectly. At the occultation of 16 Tauri, the star was lost in the glare of the moon before it came up to the limb. I used a dark wedge because it makes it much more easy to observe the bright limb of the moon. I may mention that Mr. Hilger has just completed a large half-prism spectroscope, to be sent to

Melbourne. It is here, and the Fellows may like to look at it. Mr. Hilger has paid great attention to it, and I think has secured perfect surfaces to the prisms. I gave a full description of the instrument at a former meeting. In this case there are three half-prisms corresponding with 4, 15, or 60 ordinary flint prisms of 60 degrees.

Mr. Brett: The explanation Mr. Christie has given of the encroachment of a star on the disk of the moon is interesting, but I should like to know why a similar encroachment is not always observed when a star is occulted?

Mr. Ranyard: There is a phenomenon which has been observed with regard to the occultation of the satellites of Jupiter, which I think may be explained in a manner similar to that suggested by Mr. Christie with regard to the moon. Admiral Smyth and I think also Mr. Webb have noticed that as the satellites come up to the limb of Jupiter, just before they are hidden the limb of the planet next to the satellite frequently seems to be flattened. According to this hypothesis the limb of Jupiter would be surrounded by an irradiation fringe, the light of which would be drowned by the superior brightness of the satellite, and consequently the limb of the planet would appear to recede or be flattened. The irradiation edge may also account for the observation of Mr. Todd in Australia, who some time ago described one of the satellites as having been seen through the limb of Jupiter, and some remarkable physical deductions were drawn from the observation, but in the light of the lunar observations mentioned by Mr. Christie it does not seem very remarkable.

Mr. Gill: I think I understood Mr. Christie to say the star approached a hollow or notch in the limb of the moon. That may have some possible bearing on the observation if there is a denser lunar atmosphere in the valleys,

Capt. Noble remarked that Mr. Todd's observations, according to the account in the *Monthly Notices*, had been made with a ricketty equatorial and a chronograph that would not act. He therefore thought that they must perhaps be taken *cum grano salis*.

The President said: We must not take that for granted, for many good observations have been made with a ricketty instrument. For example, many beautiful sets of drawings have been made by Dr. Temple, of Florence, where there was no clock, and the telescope was very long, and was mounted so that if touched with the finger it would vibrate like a whip.

Mr. Gill: I think Captain Noble's criticism of Mr. Todd's observation very unfair. Mr. Todd is one of our most industrious and careful observers and has an excellent telescope. I must remind Captain Noble that a telescope is not usually

clamped in right-ascension to observe the phenomena of Jupiter's satellites.

Mr. Neison; I can confirm what Mr. Christie has said with regard to the disappearance of the star. I have myself on more than one occasion made observations of the kind. You will generally observe a gradual decrease in light from the moon's limb. When a bright star comes up to the limb it disappears in the haze, as Mr. Christie remarks, but it is not lost till it comes to the true limb, within the apparent optical limb of the moon. If you observe with a transit instrument you will probably only see the outer limb, whereas if you observe with a high power and good conditions, you will see that the real limb lies within and is rather sharply marked. Small stars are lost at the outer limb, but a star of more than the fourth magnitude goes right within the limb and then disappears. An appreciable difference is found between the times of disappearance of faint stars and bright stars. The faint stars disappear rather more than half a second of arc further away from the centre of the moon. As to what Mr. Ranyard has said about Jupiter, I think the same phenomena have been described by other observers. I know in two cases seen by Ray, and I think also by Dawes, about ten years before Mr. Todd made his observations.

Mr. Christie: I will endeavour to answer the questions that have been put. Mr. Brett asks why this phenomenon is not always seen. That may be a difficult question to answer. I observed it myself on another occasion, the only other bright star I have seen occulted at the bright limb, and there I distinctly saw the projection. But I believe the phenomena of projection has been frequently referred to the colour of the star, *i.e.*, that a star is seen distinct from the moon's limb by virtue of its difference of colour. A red star is thus brought out in front of the moon. In this case it struck me as noticeable (expecting nothing of the sort) that the star should go on advancing over the moon's limb and I saw it brought out as distinctly different in colour from the moon. At the same time a great deal may depend on the observer's eye, that is, I believe, the explanation which the Astronomer-Royal has offered on effects of irradiation. The observer may see this false light on the moon's limb or not, according as he directs his attention to the moon or the star. Mr. Gill asks whether the star disappeared in the notch. It is only fair to mention there was a notch but it was not a very remarkable one, but like a good many other notches on the moon's limb. The chief point is that the definition was good enough to enable me to see the notch. I do not think what I saw can be accounted for by any atmosphere there, because the notch was very small. Mr. Neison has

remarked that there is a difference in the diameter of the moon deduced from observations of bright stars and faint stars, but Mr. Dunkin has reduced the observations of stars of the 4th and 5th magnitude at the bright and dark limbs, and they agree very well.

The President: With regard to the difference in the lunar diameter derived from the occultations of small stars and larger stars, I think that there is another explanation besides that referred to by Mr. Neison, viz., that the eye is frequently overpowered by the brightness of the limb. I have a great difficulty, for example, in seeing a star of the 7th or 8th magnitude right up to the limb. I have never yet been fortunate enough to see a real projection on the moon's limb, though I have watched many occultations in the hope of seeing a projection.

Mr. Neison: I quite agree with Lord Lindsay's explanation. It is very probable a faint star disappears because the eye is overpowered by the brightness of the limb.

The President: As to the apparent flattening of the disk of Jupiter, referred to by Mr. Ranyard, I think you may see a similar flattening when any black disk comes up to any white disk. There was something like a flattening to be seen with the artificial transit of Venus. In addition to there being an apparent optical ligament, the limb of the larger disk was apparently flattened at the time that the small disk was brought up against it.

Mr. Gill: Some observers described it as the limb of the sun being pushed out before Venus.

Mr. Downing was then called upon to read a paper *On the reduction of the north polar distances of the Cape catalogue for* 1860 *to Auwers' standard.* He said: When comparing catalogues together for such purposes at the determination of proper motions, it is of course necessary, where extreme accuracy is required, to reduce the places of stars given in the different catalogues to a uniform standard, so that the systematic discordances peculiar to each individual catalogue may be thus eliminated. The standard usually adopted for north polar distances is that given by Dr. Auwers in No. 1,536 of the *Astronomische Nachrichten,* and in the present paper I have investigated the corrections which it is necessary to apply to the N.P.D. of the Cape Catalogue for 1860 to reduce them to this standard. The Cape Catalogue has first been compared with the Greenwich Seven-year Catalogue for 1860, and then, by means of the corrections to the latter, given by Dr. Auwers, the corrections applicable to the Cape Catalogue have been found. For southern stars, between N.P.D. 120°, and the south pole, the Cape Catalogue has been compared with Henderson's Catalogue, published in the 10th Volume of the

Memoirs; as Dr. Auwers has taken this as a provisional standard for southern stars, there not being sufficient materials for the formation of an independent standard. The catalogues have been compared directly and also indirectly by means of Johnson's St. Helena Catalogue, and the mean taken as the adopted comparison with Henderson's Catalogue.

Mr. Green was called upon to show a map of the planet Mars. He said: I have recently received a communication from Mr. Trouvelot, of America, with reference to some observations of Mars. I had sent him some of my drawings; he says—"I have been agreeably surprised at the close agreement between independent observations even in minute details." I am glad to say that he also confirms my observations of the jagged outline of the polar spot. He says of the canals: "about the canals observed by Signor Schiaparelli, my observations give them very little support." Mr. Trouvelot observed the planet every clear night from April, 1877 to May, 1878, making 218 observations, and 212 drawings. There is a point lately mentioned in the observations of Mr. Dreyer,* at Parsonstown, which to a certain extent bears on this matter. I thought on one occasion, when I was in Madeira, that I had seen a ligament joining the Lockyer sea to the De La Rue sea, and this may throw some light on the canals of Signor Schiaparelli, because when definition is imperfect the eye seems to have a tendency to imagine a continuation or elongation between two points. I believe that imperfection of definition will have a great deal to do with many of these puzzling points; and if we would only be a little more patient, and make allowances for atmospheric vibrations and other difficulties in comprehending what is seen, there would not be so many contradictions between observers. I have been busy preparing a map of Mars, and I hope it will appear together with the Madeira drawings.

Mr. Knobel: I have seen the map, and would suggest that before it is printed it should be referred to one or two Fellows who are acquainted with the drawings that are extant of Mars, to discuss it impartially. I notice that of one or two features of Mars which I have myself delineated there is no resemblance on the map; and a reference to a committee of impartial Fellows may make it a valuable map.

Mr. Banyard: I should be inclined to recommend a committee if it is proposed to place any new names upon the planet. I should be sorry to propose anything that would obstruct Mr.

* [Note by Mr. Green.] Mr. Dreyer's observation was quoted from the publications of the Royal Irish Society.

Green in his work, but the weight of the Society ought not to be given to any additional naming or even to a new map of the planet, without an opportunity being afforded to those who are interested in the planet of discussing the proposed additions and alterations. With markings like those upon the planet (which lie very near to the limits of what is visible), every new map has a tendency to affect subsequent drawings, a tendency which perhaps observers themselves are not able to properly estimate. There is an interesting point with regard to this map of Mr. Green's. The great equatorial girdle of continents on Mars seems to lay more to the north than in Mr. Proctor's map, thus causing the analogy between the Earth and Mars, as to the development of land in the northern and southern hemispheres, to be more evident. Mr. Green's map appears to have been compiled mostly from drawings made when the southern pole of the planet was turned towards us; and the northern snow cap is consequently much larger than the southern. Roughly speaking, Mars may be described as having a northern and southern snowcap, each surrounded by an annular sea, which is again surrounded by an annular island or continent. Outside this is another ring of seas, and then comes the equatorial girdle of continents. Part of the difference between the northern and southern snowcaps is, no doubt, due to the fact that the axis of Mars, which is inclined at more than 27° to the plane of the orbit, is so situated that the summer of the northern hemisphere occurs when Mars is nearly at his greatest distance from the sun, and the summer of the southern hemisphere occurs when Mars is near to perihelion, and 26 millions of miles nearer to the sun than during the summer of the northern hemisphere. But the fact to which I wish to draw attention is, that in this map of Mr. Green's the development of sea in the southern hemisphere is more striking than in Mr. Proctor's map; and thus the analogy between the Earth and Mars is made more evident.

The President: I would only make one remark as to what Mr. Green meant by bad definition, turning *points into lines*. Does he suggest that bad definition would produce a description of astigmatism?

Mr. Green: The answer I would make to that is simply that the atmospheric vibrations have a tendency to cause a series of points in a line to appear connected together, and this, I think, may account for some of the lines and channels on Schiaparelli's drawings. With regard to Mr. Knobel's proposition, I should be quite delighted if anyone will give me any help. I came here for it and shall be glad to receive it.

Mr. Sadler: I question whether with the telescope which

Signor Schiaparelli used it was possible for him to see the minute canals he gives. I have looked carefully at his map of Mars, and some of his canals appear to be under the tenth of a second in diameter, and with the 8-inch which he used it would be impossible to see canals of that size.

Mr. Neison was called upon to read a paper *Upon a complete general solution of the problem of disturbed elliptical motion.* He said: This is an attempt to obtain a complete solution of the equations of motion of the planets of the solar system, or of the motions of any similar bodies. There have been many attempts to obtain a solution of this problem, which is to determine the motion of a body moving in an ellipse round a larger or central body, and disturbed by the action of other bodies at a considerable distance. The effect of these disturbances is that the planet is caused to move in an ellipse in an irregular instead of in a regular manner. Usually the first step is to suppose its motions regular, and that the disturbances give rise to four or five different classes of irregularities, all of which have to be calculated and allowed for. This paper is to show how the entire effects may be calculated at once. It is impossible to go any further into the matter here, but it can be studied in print.

Mr. Thornthwaite showed a variable diaphragm for use in solar and sidereal observations, which had been devised by Mr. Levander. He took the opportunity of suggesting that by means of a cylindrical lens the elongated images which had been referred to by Mr. Gill might be rendered circular and superposed.

Mr. Gill said he thought if Mr. Thornthwaite tried to apply a cylindrical lens to a heliometer he would find the attempt surrounded with many difficulties. Moreover, the superposition of one disk upon another was the worst possible principle to use for measuring.

Mr. Ranyard: I should like to correct an oversight I made at the last meeting. Mr. Schuster read a paper on the recent eclipse, in which he drew attention to a matter which has been observed by more than one polariscopic observer during recent eclipses, viz., that the polarization of the corona does not decrease regularly as you pass outwards from the sun's limb, but that there is an area of maximum polarization at a certain height above the sun's limb. Mr. Schuster showed that the polarization of the light dispersed by small particles in the corona should increase as you pass away from the sun. His proof only applies to the light dispersed by single elements of the corona, but the same thing is true, as I have shown in the eclipse volume, if we take into account the polarization of the light derived from all the elements of the corona seen in the same line of light by an observer at the earth.

Mr. Schuster's method of reconciling the observed facts with theory, is to suppose that in the higher parts of the corona a condensation of matter takes place, and that the light is dispersed by larger particles according to a different law. It seems probable that any such change in the physical condition of the matter of the corona would be accompanied by a change in the intensity of the light dispersed. But there is no evidence afforded by the photographs of any sudden change of brightness corresponding to the area of maximum polarization, in fact there is nothing which looks like concentric structure, indicating regions of dissociation and condensation such as theorists have frequently referred to.

The more probable explanation of the decrease in the intensity of the polarization in passing outwards is that the polarization of the faint light of the outer corona is drowned by the light dispersed by our atmosphere, through which the corona is observed. This is the explanation I have suggested in the eclipse volume, and when we consider the circumstances under which the corona is observed, I think it seems the most probable explanation. During totality the atmosphere between the observer and the sun is lit up by light derived from clouds, and the sky about the sun's place disperses a considerable amount of light which is found to be faintly polarized in a plane perpendicular to the horizon. In considering the polarization of the light derived from any part of the visible corona, we shall have to consider what will be the polarization of the light which is compounded of the light derived from that part of the corona and the light dispersed by the atmosphere. Now, though the polarization of the light of the corona increases rapidly as we pass away from the sun's limb, the intensity of the light of the corona decreases very rapidly, and the consequence is that the radial polarization of the total light diminishes outside a certain point. During the recent eclipse, and also during the eclipse of 1871, it would seem that the radial polarization was very clearly visible close to the sun's limb, and that the intensity of the radial polarization did not decrease very rapidly from the area of maximum polarization down to the sun's limb, so as to cause the area of maximum polarization to appear as a very marked feature. In fact, some of the observers during the recent eclipse described the polarization as decreasing from the limb outwards. Now this shows that there cannot be any considerable mixture of unpolarized light with the light dispersed by the small particles of the lower corona, for such an admixture would tend to obliterate the polarization of the lower parts of the corona, so that there would be a rapid increase of polarization from the limb outwards. This reasoning becomes more striking when we consider all the other causes which must tend to obliterate

the polarization near the limb, such as the large angle which the photosphere subtends to particles floating in the lower corona and the admixture of incandescent particles with the coronal matter. We may therefore assume that the light of incandescent gas which would be unpolarized does not form a large proportion of the light of the lower corona, and consequently that the monochromatic images of the corona must be very faint compared with the total light of the corona.

Mr. Brett said: I understand that the Society was peculiarly favoured at the recent eclipse by having one of its Secretaries who observed it exceptionally well. Hitherto it has been the practice for Fellows of the Society to give their experience to the Society, or else present them to the Royal Society, and it is quite an innovation that the Fellows should be obliged to look to the American papers for an account of what English astronomers have been doing. From the American papers I find that two very interesting observations had been made by Mr. Ranyard, and it would be gratifying to the Society if Mr. Ranyard would explain them. We were told he had made a photograph of Young's stratum. Now I did not know Young had a stratum. We all know who the corona belongs to, but I did not know that any stratum belonged to Prof. Young, and I should like to know some more about it, and to know what a 13-inch camera with a 6-foot focus is.

Lord Lindsay said: It should be remembered that American newspaper reporters are very quick at picking up information. It requires some time, as I very well know, to prepare a report of an astronomical expedition, but I have no doubt that Mr. Ranyard will shortly give us some informatian about his observations

Captain Noble said Mr. Brett must have a very short memory, or he would have remembered that a friend of his, a Fellow of the Society, studiously kept the results of the solar eclipse of 1871 from it, while he was hawking them about in a certain publication, and selling them to any one who would pay to hear him lecture at the Crystal Palace.

Mr. Ranyard said it was too late to say much, but he held in his hand the better of the two photographs which was taken with a lens of 13 inches in diameter, which Mr. Esdaile had put at his disposal. The camera was mounted equatorially. His reason for not having prepared a report on his observations before this was that some years ago he undertook to edit the observations of the eclipse of 1870, and soon afterwards the results of the eclipse of 1860 were put into his hands, and then came the eclipse of 1871. It seemed to him he would be serving the Society best if he continued his work at this volume which was

all but finished, before he passed on to the observations of the recent eclipses.

Lord Lindsay showed a series of drawings of the area about the lunar crater Hyginus, from which it appeared that many small craters and markings upon that part of the lunar surface are only visible for a very short time when near the terminator. He showed drawings which had been made by Dr. Copeland, by way of caution to those observers who seemed inclined to consider that because a crater or lunar marking had not been noted before it must, therefore, be a new formation. He stated that some of the markings shown upon the drawings appeared and disappeared in a period of twenty minutes.

The meeting adjourned at a quarter past ten.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.
To all communications must be annexed the name and address of the sender, as a guarantee of good faith.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

EXPLANATION OF NAMES on MAP of the MOON.

Sir,—I have lately obtained, after a search of several years, an exceedingly good copy of a scarce book, entitled "The Sphere of Marcus Manilius," published in folio, which contains a comprehensive catalogue of astronomers from the earliest times to the middle of the seventeenth century, and gives, not merely their names, and the periods in which they severally lived, but also some interesting particulars respecting them and their publications. I therefore beg to send you a kind of supplement to Lord Lindsay's paper on this subject, which appears in the last number of your journal. I trust, also, that it will enable you to remove several of the notes of interrogation which you have appended to same names in your own list.

I am, Sir, your obedient servant,

The Observatory, Crowborough, C. L. PRINCE.
Tunbridge Wells: Dec. 4, 1878.

Alexander Ephesius, surnamed Lychnus. B.C. 50. He is mentioned by Strabo, lib. 14. He wrote an astronomical poem of the heavens, and a commentary in Arati Phænomena.

Alfraganus Mahumedes. A.D. 950. He wrote several astronomical works, which were translated into various languages.

Bacon, Roger. A Franciscan friar of Oxford. A.D. 1255. He

wrote a vast number of books upon various subjects, chiefly astronomical.

Bettinus Marius. A native of Bologna. He wrote several mathematical works, and one in vindication of himself, being accused by Ricciolus of committing many errors in astronomy. A.D. 1650.

Blanchinus Johannes (not *Blanchinius*). A.D. 1462. He composed several astronomical tables, which were published in 1526 by Gauricus.

Cleomedes. A.D. 390. A learned astronomer and philosopher. He wrote two works which were published in Greek and Latin, and printed at Bordeaux in 1605.

Curtius Albertus. A Jesuit of Bavaria, A.D. 1627, whose ingenuity in the theory of the moon Kepler not only admired but commended.

Dionysius Afer. B.C. 30. Wrote a poem "De situ orbis." He was sent by Augustus before his adopted son Caius into the East, the better to describe to him those regions.

Dionysius Areopagita. A.D. 34. It is reported of him that at Heliopolis in Egypt he observed that miraculous defection of the sun at the time of Christ's passion, whereupon he broke out into this exclamation. "Aut Deus naturæ patitur, aut mundi machina dissolvitur." He died a martyr when above 100 years old.

Dionysius Exiguus. A Roman abbot. He computed a paschal cycle which was observed by the Latin church until the correction of the calendar by Greg. xiii.

Epigenes Byzantinus. B.C. 270. Was an author of credit. Hath left it recorded that, among the Babylonians, there were found ephemerides containing observations of the stars for the space of 780 years, inscribed in brick and tiles. He wrote also, as Seneca affirms, of comets.

Furnerius. Should be Fournerius.

Furnelius Joannes. A.D. 1528. A French physician. Wrote a particular treatise, entitled "Cosmotheria," in which he explained the motions of the celestial bodies, also a number of other works.

Gerardus Rupelmundanus. A.D. 1595. He wrote a book, "De fabrica mundi et fabricati figura."

Goclenius Rudolphus. A.D. 1613. Doctor of physic and professor in the university of Marpurg. Wrote several works which were printed at Cologne.

Gruemberger. Should be *Griemberger.*

*Hippalus.** Can this be intended for Harpalus, B.C. 520? who

* In Grimaldi's *Selenography*, Harpalus appears, but not Hippalus.

corrected the Octæteris of Cleostratus, according to whose opinions, at the expiration of every ninth year the new moon returned again at the same hour, unto the same point of the heavens in which it was nine years before.

Lubienietzki. In the edition of his Theatrum Cometicum, which I have, is a fine engraving of him, on the margin of which is printed "Stanislaus Lubienietzki de Lubienietzki Rolitsius Æt. XLI." This book was printed at Amsterdam in 1667.

Macrobus Ambrosius. A.D. 390. Consul of Rome. Wrote in his Saturnalia divers astronomical arguments.

Marinus Mersennus. A.D. 1645. A Frenchman. A friar of the order of St. Francis de Paulo. In his Mathematical Synopsis, not only by his own industry, but also by the publication of others' learned labours, contributed much to the advancement of astronomy.

Mercurius Trismegistus vel Hermes. B.C. 1480. A Greek propagator of astronomy among the Egyptians. His books are mentioned by Eusebius.

Neperus Johannes. A.D. 1614. Lord of Merkinstone, in Scotland. Inventor of logarithms, for which he merits "eternal commendation."

Œnopides. B.C. 560. Had an eminent knowledge of astronomy. He is reported to have set up a brass table at "the Olympicks," having written thereon the astronomy of 59 years.

Simpalius. Should be *Sepalius Hugo,* A.D. 1635. By birth a Scotchman, by profession a Jesuit in the College at Madrid. He wrote "De Astronomia," "De Astrologia," and "De Calendario," which were published at Antwerp.

Stevinus, Simon. A.D. 1590. Of Bruges. Wrote several works upon the planets and tables of celestial motions.

Timochares. B.C. 294. Observed the fixed stars, and particularly one of eight stars in Lyra mentioned by Theon upon Aratus.

Zagut, Abraham. A.D. 1473. Of Carthage, afterwards at Salamanca. It may be mentioned of him that he was the most celebrated astronomer of his day, and enjoyed the title of "Astronomiæ Consultissimus."

NOMENCLATURE OF MARKINGS VISIBLE UPON THE PLANET MARS.

[We have requested some of our correspondents to give their opinions upon the best method of naming the objects which may be observed upon the planet Mars. Only three letters have been received in time for publication in the present number, but we hope that the subject will be more fully discussed in the pages of the *Astronomical Register.*—ED.]

Sir,—I send the following suggestions in answer to your request that I should state in writing what I consider would be the best method of naming the bright and dark markings seen upon the planet Mars.

The principal markings, about which there appears to be but little difference of opinion amongst observers, might be selected and described by names indicating a resemblance or supposed resemblance with terrestrial objects. These names could then be used as constellation names, and the other more doubtful markings could be referred to by letters of the alphabet attached to the name of a contiguous object of the first-class. Thus, for example, Mädler's spot *d* is frequently referred to as the "Oculus," and the objects around it would be referred to as "Oculus A," "Oculus B," &c.

The names of objects of the first-class should preferably be derived from the Latin or Greek. Such names as Smith's ocean, Jones's continent, are open to a twofold objection—not only does the name imply a terrestrial analogy which hereafter, as in the case of the Maria upon the moon, may be shown to have no existence, but the terms ocean, continent, will need to be translated into foreign languages, thus preventing the uniformity of nomenclature which is desired.

Up to the present time the use of personal names in astronomical nomenclature has not been successful. Galileo called the satellites of Jupiter the Medicean stars; Cassini proposed to call the satellites of Saturn which he had discovered the Ludovicean stars in honour of Louis XIV.; Herschel I. called Uranus, Georgium Sidus, and his friends christened it "Herschel," but the planet is now universally known as Uranus. Some of the least euphonious names made use of in botany and mineralogy are those derived from the names of persons, and in chemistry the practice seems to have been abandoned.

The present condition of Martian nomenclature is, I think, as follows:—

Mädler in 1830 designated some of the principal markings on the planet by letters of the alphabet.

Kaiser in 1862 and 1864 laid down upon a globe some of the principal markings shown in his own drawings and in those of Mädler, and added a few more letters.

Proctor in 1869 made a chart which was principally compiled from the drawings of the planet by Dawes; the continents and seas were chiefly apportioned amongst modern observers, many of whom were English, and a few of the smaller continents and seas were named after earlier astronomers and mathematicians.

Terby more recently has given some additional names, and has expended a great deal of time in comparing drawings of the planet.

Flammarion being dissatisfied with some of the names given by Proctor and Terby, renamed a great many of the markings.

Schiaparelli has during the past year added to the confusion which already existed by entirely renaming the markings, which according to his observations are to be seen upon the planet.

Yours faithfully,

A. COWPER RANYARD.

Dear Sir,—As regards the question of the nomenclature of spots on Mars, I have expressed my opinion about it some months ago, when I had to make some remarks on Schiaparelli's "Osservazioni di Marte," and I may perhaps quote here the words then used:

"For the designation of the different regions of Mars, Schiaparelli has introduced quite a new nomenclature. The new names, chiefly chosen from classical geography, are given on the chart in Latin, and in the text in Italian. However preferable these names may be to the English and French ones, which of late years have been introduced in popular treatises, it is pretty certain that practical astronomers will not load their memories with such useless rubbish. Big letters to designate the larger regions in the order of the planet's rotation, and small letters attached to them to note special points in each region, will provide sufficient and convenient means for easily marking and finding any point on the planet's surface."

The south and north polar spots may be designated either S. and N. or A. and B. (Australis and Borealis) and, in the latter case, the spot through which the first meridian is laid, may be C or O. If the regions or spots which follow in the order of rotation or of areographical western longitude, are then lettered in alphabetical order, no effort of memory will be required to know in which longitudes they are to be found. Of course, observers who prefer lengthier descriptions, are welcome to use them and to introduce any amount of additional names, provided they will kindly add the letters of notation. When, nearly half a century ago, Mädler constructed the first tolerable chart of Mars from his own observations, he contented himself with designating the chief markings by small letters. But then he clearly knew what he was about, and did not neglect to determine the areographical positions of the chief spots as well as the modest means at his disposal allowed. He certainly did not then anticipate that, half a century later, observers with far superior means would neglect the splendid opportunities of 1877 for making numerous

observations corresponding with his own, by which the question of the planet's rate of rotation, the position of spots, and other kindred matters, might have been more satisfactorily settled. Though Mädler's mode of lettering requires alteration and expansion, the principle of notation adopted by him is the simplest and most practical, and ought not to be abandoned.

Yours faithfully,

A. MARTH.

Sir,—I should propose that the spots and markings upon Mars be named by the letters of the alphabet, like the lines in the spectrum. The present plan of christening continents and seas by the names of contemporaries may be a very graceful and pleasing act, from a social point of view, but it is unfair, inasmuch as it anticipates the verdict of posterity.

Bianchini, when naming the continents and seas of Venus, as delineated in his "Hesperi et Phosphori Observationes," was careful only to make use of the names of ancient geographers. La Caille, when he was about to introduce new constellations to fill up gaps between the older figures of the southern hemisphere, was recommended by his friends to name them after Louis XV. and other reigning sovereigns, as princely favours were sure to follow, but though a poor man he resisted the temptation.

If modern names are to be made use of upon Mars, let it be made the means of raising a revenue for astronomical purposes. Let the matter be put into the hands of an advertising agent, who will know how to charge so much for a whole continent and so much for a part of a continent. Our contractor would, of course, not be so short-sighted as to part with the freehold of large tracts of country in perpetuity, but would grant leases for short terms of years.

I am, &c.,

HERBERT SADLER.

NEW VARIABLE (?) STAR.

Sir,—The star 38 Aurigæ was rated 6m. by Heis, and 39 Aurigæ 6·7m. 38 is also estimated as brighter than 39 in the *Durchmusterung*. Sir W. Herschel rated them exactly equal. 39 is at present *distinctly the brighter* of the two (about $\frac{1}{4}$ mag.), so that one of the stars is probably variable.

Nov. 20, 1876. I found 39 fully half a magnitude brighter than 38.

March 31, 1877. 38 and 39 nearly equal.

Peirce *(Annals of Harvard College Observatory, Vol. IX.)* estimates 38 at 6·07 and 39, 5·90, or about $\frac{1}{6}$ mag. in favour of 39.

Nov. 21, 1878. J. E. GORE.

ASTRONOMICAL OCCURRENCES FOR JANUARY, 1879.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Wed	1		Sidereal Time at Mean Noon 18h. 43m. 3·69s.			α Persei. 8 31·3
Thur	2		Sun's Meridian Passage 4m. 13·46s. after Mean Noon			8 27·3
Fri	3	3 48	Occultation of ε Arietis (4½)			8 23·4
		4 25	Reappearance of ditto			
Sat	4			1st Tr. I.	6 10	8 19·5
Sun	5			4th Sh. I.	4 15	8 15·5
				2nd Ec. R.	5 39 37	
				1st Ec. R.	6 19 1	
Mon	6	11 4	Occultation of 139 Tauri (5½)			8 11·6
		11 56	Reappearance of ditto			
Tues	7	23 47	○ Full Moon			8 7·7
		5 14	Near approach of ε Geminorum (3½)			
		14 16	Occultation of ω Geminorum (6)			
		15 9	Reappearance of ditto			
		16	Conjunction of Jupiter and θ Capricorni 0° 7′ N.			
Wed	8					8 3·7
Thur	9	16 30	Occultation of o^2 Cancri (6)			7 59·8
		17 5	Reappearance of ditto			
Fri	10					7 55·9
Sat	11					7 51·9
Sun	12			2nd Oc. D.	4 26	7 48·0
				1st Oc. D.	5 28	
Mon	13			1st Tr. E.	5 3	7 44·1
				1st Sh. E.	5 31	
Tues	14	23 1	☾ Moon's Last Quarter			7 40·1
Wed	15		Illuminated portion of disc of Venus=0·987			7 36·2
			Illuminated portion of disc of Mars=0·937			
Thur	16	15 54	Occultation of B.A.C. 4984 (6)			7 32·3
		16 31	Reappearance of ditto			
Fri	17		Sidereal Time at Mean Noon 19h. 46m. 8·62s.			7 28·3
Sat	18	18	Conjunction of Moon and Mars 3° 41′ N.			7 24·4
			Sun's Meridian Passage 10m. 37·86s. after Mean Noon			
Sun	19					7 20·5

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Mon	20	1	Conjunction of Moon and Mercury 3° 16′ N. Saturn's Ring: Major axis=37″·58 Minor axis= 1″·98			α Persei. — 7 16·5
Tues	21	23 50	● New Moon Eclipse of the Sun, invisible at Greenwich	Sun.		7 12·6
Wed	22					7 8·7
Thur	23	1	Conjunction of Moon and Venus 2° 37′ S.	the		
		2	Conjunction of Moon and Jupiter 1° 54′ S.	to		7 4·7
		15	Conjunction of Jupiter and Venus 0° 47′ S.			
Fri	24			nearness		7 0·8
Sat	25					6 56·9
		5 11	Occultation of λ Piscium (5)			
Sun	26	5 53	Reappearance of ditto	his		
		19	Conjunction of Moon and Saturn 7° 18′ S.			6 52·9
		19	Neptune at quadrature with the Sun	through		
		6 4	Occultation of 45 Piscium (6)			
Mon	27	6 35	Reappearance of ditto			6 49·0
Tues	28			ble		6 45·4
Wed	29	23 44	☽ Moon's First Quarter	visi		6 41·1
Thur	30			in		6 37·2
		11 28	Occultation of 16 Tauri (5½)			
		12 33	Reappearance of ditto			
		11 34	Occultation of 17 Tauri (4)			
		12 23	Reappearance of ditto			
		11 50	Occultation of 19 Tauri (5)	satellites		
		12 37	Reappearance of ditto			
		12 0	Occultation of 20 Tauri (5)			
Fri	31	13 1	Reappearance of ditto			6 33·3
		12 42	Near approach of 23 Tauri (5)			
		13 2	Occultation of η Tauri (3)			
		13 25	Reappearance of ditto			
		13 45	Occultation of 28 Tauri (5½)	Jupiter's		
		14 12	Reappearauce of ditto			
		13 58	Near approach of 27 Tauri (4)			
FEB.						
Sat	1					6 27·3

THE PLANETS FOR JANUARY.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury...	1st	17 45 27	S. 20 12½	9″·0	22 58·6
	9th	17 47 46	S. 21 43	7″·8	22 29·5
	17th	18 17 34	S. 22 15½	6″·4	22 27·8
	25th	19 0 7	S. 22 4	5″·8	22 38·7
Venus ...	1st	19 15 7	S. 23 17	9″·8	0 32·0
	9th	19 58 17	S. 21 52	9″·8	0 43·6
	17th	20 40 22	S. 19 45	10″·0	0 54·1
	25th	21 21 7	S. 17 1½	10″·0	1 3·3
Saturn ...	1st	23 53 3	S. 3 15	15″·6	5 9·2
	9th	23 54 53	S. 3 1½	15″·4	4 39·5
	17th	23 57 2	S. 2 46	15″·2	4 10·2
Uranus ...	13th	10 23 32	N.10 54	4″·2	14 50·7
	25th	10 22 1	N.11 2	4″·2	14 2·0
Neptune...	1st	2 21 20	N.12 10½	...	7 37·0
	17th	2 21 3	N.12 10	...	6 33·8

Mercury is well situated for observation. He rises an hour and a quarter before the sun on the 1st, the interval increasing to an hour and three-quarters on the 11th, from which day the interval gradually decreases.

Venus sets about half an hour after the sun at the beginning of the month, the interval increasing.

Saturn may be observed till about an hour before midnight on the 1st, the interval increasing.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JANUARY, 1879.

BY W. R. BIRT, F.R.A.S., P.S.S.

Attention has lately been called to the following objects as affording suitable employment for telescopes of moderate power. The interior of Posidonius. The light streaks from Proclus, which may occupy observers very profitably; *first*, in determining the earliest epoch at which they may be detected radiating from Proclus; *second*, in noticing their direction as they pass over or near to, as also between conspicuous objects on the Mare Crisium, and *third*, from what part of Proclus they take their rise, whether from within or above the crater. Precisely the same kind of observations may be made on the remarkable objects Messier and Messier A. The Mare Serenitatis appears to have been sadly neglected of late years; a rather extensive catalogue of its craters is in existence, with their localities, and if it were *proved* by observation that one only could not be found, or one had appeared where none had been recorded previously, it would be a great gain to selenography. Observers, so far as publication is concerned, have not systematically examined it. Very little advance will be really made in selenography unless there are steadily continuous series of observations of well-selected portions of the moon's surface, undertaken by men who are willing to labour without deriving any immediate or apparent results, which will not fail to show themselves as a well-conceived course of observations proceeds.

At the December meeting of the Royal Astronomical Society, Lord Lindsay exhibited a series of drawings of the area about the lunar crater Hyginus, and called attention to the fact that some of the markings shown upon the drawings entirely changed in appearance in about twenty minutes.

This phenomenon characterises very generally the appearance of objects *near the terminator*, indeed it is very difficult to obtain anything like a correct idea of any portion of the moon's surface while the terminator is passing over it. The angle at which the sun's light impinges on it is so small that the most insignificant irregularity assumes considerable prominence, and so numerous are these irregularities that the appearance of the surface is often very confusing; it is when the terminator has passed onward and the sun has obtained a certain altitude, mostly about a day after the passage of the terminator, that the real character of the surface becomes apparent, and it is not until after the disappearance of the shadows of the smaller objects that the permanent features of the country can be made out, and the study of a particular locality can be proceeded with.

In Lord Lindsay's "Explanation of names on the map of the moon," *Astronomical Register*, December, page 306, his lordship gives three probable references to "Alexander," of which the first, "Alexander the Great," was the one I had in mind when the name was given. The formation being nearly in the same meridian as Julius Cæsar, Alexander appeared to me as an appropriate designation for it.

Lord Lindsay is quite right in his suggestion that I meant a peak mentioned by Prof. Smyth in his astronomer's experiment. The following paragraph contains Piazzi Smyth's mention of it: "Interesting as is Chajorra viewed by itself, the interest rises on comparing it with Rambletta and Montaña Blanco; they are the triple heads of the one central peak or cone of eruption that rises in the midst of the great elevation crater. Brethren are they, with a more than *Siamesan* union, yet of different ages; the oldest and tallest being Rambleta with its Piton crest.

THE MOON.

I have just read the second edition of Mr. Proctor's book. Can any of your readers inform me of a good work entirely on the configurations, etc., of the moon's surface.

T. P. G.

The Lodge, Clapham Road, Bedford.

MINOR PLANET VESTA.

The minor planet Vesta, the fourth of the series, will come into opposition on the 6th of the month.

	R. A.	Dec.
	h. m. s.	° ′ ″
Jan. 1.	7 18 2·16	N. 22 37 23
4.	7 14 44·91	N. 22 52 7
6.	7 12 31·68	N. 23 1 49

WILLIAM LINDSAY BANKS.

With great regret we have to announce the death of one of our best and earliest correspondents. Mr. W. L. Banks died at Ealing on July 23, 1878, at the age of 72. During the last years of his life he suffered greatly from a most painful disease, but never lost that cheerful and patient frame of mind that had been his peculiar charm in the brighter days of his health and strength. He was for many years devoted to the study of astronomy. Being a proficient in the use of the pencil and brush, his views of the planets were most truthful and artistic. The planet Mars was an especial favourite, and at each opposition he delighted to renew his drawings, producing a full and most effective series on each occasion. A set of these views for the oppositions of 1862 and 1864, were published in this journal. He was also a good botanist, linguist, and musician. Possessing a mind thus stored with the treasures of scientific lore, he was singularly humble and unpretending in his intercourse with others. Those who knew him best admired him most.

Book Received.—Thirteenth Report of the Observatory of Victoria. Melbourne: John Ferres.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Sept., 1878.
London Institution.

To Dec., 1878.
Bridson, J. R.
Dobie, Dr.
Hannay, R.
Hollis, H. W.
Huggins, W.
Normand, A.

To March, 1879.
Gray, T. P.

To Dec., 1879.
Andrews, W.
Barber, J. T.
Böe, A. de.
Chadwick, S. J.
Draper, Prof. H.
Jefferies, J.
Johnson, Rev. S. J.
Jones, Rev. E.
Joynson, J.
Knott, G.
Lambert, O.
Murgatroyd, J.
Perrins, J. D.
Rogerson, G. R.
Tidmarsh, J. B.

TO CORRESPONDENTS.

We cannot publish communications which are not authenticated by the name and address of the sender, as a guarantee of good faith.

When subscriptions sent by post are not acknowledged in the next number, the Editor will be much obliged if subscribers will *at once* inform him of the fact.

All Letters requiring an answer must enclose a penny stamp.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or *penny* postage stamps, but the Editor will not be liable for loss in transmission.

Post Office Orders for *the Editor* are to be made payable to John C. Jackson, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage to all parts of Great Britain and Ireland) is fixed at **Three Shillings** per Quarter, *payable in advance*, by Penny postage stamps or otherwise. Subscribers in America may remit, either by post office order or in notes, 3½ dollars, in payment of one year's subscription, postage included.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. Jackson, 11, *Angel Court, Throgmorton Street, E.C.*, **not later than the 20th of the Month.**

The Astronomical Register.

No. 194. FEBRUARY. 1879.

ROYAL ASTRONOMICAL SOCIETY.

Session 1878—79.

Last Meeting of the Session, January 10th, 1879.

Lord Lindsay, M.P., F.R.S., &c., *President*, in the Chair.

Secretaries—Mr. Glaisher and Mr. Ranyard.

The minutes of the preceding meeting were read and confirmed,

Prof. Asaph Hall, of the United States Naval Observatory, Washington.

Prof. A. Krueger, of the Observatory, Gotha.

Prof. C. H. F. Peters, of Clinton, U. S. A.

Prof. H. C. F. C. Schjellerup, of Copenhagen,

were, at the recommendation of the Council, elected Associates of the Society.

Lieut. C. W. Baillie, R.N., Imperial Naval College, Yeddo, Japan.

Fred. Wm. Clerk, Esq., 1, Royal Exchange, London, E.C.

Thomas Cushing, Esq., 1, Woodstock Villa, Alexandra Road, Croydon.

Robert T. A. James, Esq., Campsbourne, Hornsey, N.

Rev. J. H. Morgan, St. Augustine, Honor Oak Park, S.E.

Charles Pendlebury, Esq., B.A., St. John's College, Cambridge.

Prof. C. W. Pritchett, M.A., Morrison Observatory, Glasgow, Missouri, U. S. A.

Capt. James Rankin, Orchard Villa, Queen's Road, Forest Hill, and

Dr. Arthur W. Wright, of Yale Cottage, Connecticut, U. S. A.

were balloted for and duly elected Fellows of the Society.

Mr. Dunkin was called upon to read a paper by the Astronomer-Royal *On occultations of stars by the moon, and the phenomena of Jupiter's satellites observed at Greenwich during the past year.* He said: The Astronomer-Royal considers it important to publish these observations as soon as possible after the end of the year, rather than wait for the publication of the Greenwich volume. The paper comprises the occultation of seven stars by the moon, rather a small number considering there are so many in the *Nautical Almanac,* but it should be borne in mind that last year the weather was exceedingly cloudy, that very few occultations could be observed, but I am happy to say, with regard to Jupiter's satellites, we have been more fortunate. In a paper written some time ago the Astronomer-Royal recommended that observations of Jupiter's satellites should be made more frequently. It has been the custom at Greenwich to observe the eclipses, transits, and occultations of the satellites as often as practicable, but these observations were generally neglected at other observatories. Since, however, the Astronomer-Royal called attention to the matter the Society has had communications from Spain, America, and Australia, and during last year at Greenwich we had a longer series of observations than usual. Jupiter is increasing in his declination, and is coming nearer the equator, and as he gets into north declination we shall probably have a longer list of observations to show. There is nothing remarkable about the observations except that on one occasion, during the transit egress of the fourth satellite, Mr. Christie found the predicted time was so far out that the phenomenon was over 20 minutes before it was expected.

My second paper is merely a note on what I regard as a very important matter. You will remember that in the discussion on the paper by the Astronomer-Royal, at the last meeting, on the conjunction of Mars and Saturn, some remarks were made on the very large tabular error of Bouvard's tables, deduced from a single comparison of the tabular places in the *Nautical Almanac* for Dec. 32, 1879, and Jan. 1, 1880. That difference appeared to me much larger than what we find from actual observation, and as a matter of curiosity I have collected all the observed tabular errors of Saturn during the last 11 years, so as to see exactly the rate the errors are progressing. Everybody knows that the tabular error varies in different parts of the orbit of the planet, but the variation should go on with some degree of regularity from year to year. Now I have put down in the form of a table the difference between the places of the planet Saturn, as deduced from Bouvard's tables and as actually observed. The numbers have been deduced from observations made near opposition, and when Saturn passed the meridian at six hours, or near the time of the

planet's quadrature with the sun. I have calculated the angular distance between the observed and tabular places from which the tabular error from year to year may be seen. Beginning with 1872, when Saturn passed at six hours in the evening, because that hour is comparable with the time at the end of the year when the comparison of the tables is made. The following are the observed errors of Bouvard's tables, deduced from the groups nearest six hours, observed at Greenwich:

		″
1872	=	5·5
1873	=	6·1
1874	=	6·9
1875	=	9·1
1876	=	9·7
1877	=	11·2
1878	=	11·5

and in 1879, from a comparison of Bouvard's tables with Le Verrier's tables given for the last day of this year and the first day of the following year—

1879 = 21″·9

I think you will be able to see the general progress of the errors from year to year. No doubt the error is increasing. I have also given in the table the errors at opposition which are considera bly larger, viz.:

1872	=	10·0
1873	=	11·1
1874	=	9·6
1875	=	13·2
1876	=	13·5
1877	=	12·8
1878	=	14·1

Assuming Le Verrier's tables of Saturn to be correct, the tabular error of Bouvard's tables in geocentric longitude at the end of 1879 is —18″·7, and in ecliptic polar distance —11″·2, equivalent to 21″·9 between the old and new tables. Though the tabular error of Bouvard appears to be increasing at present, we should hardly expect so great an increase as 10″ in the interval between Dec., 1878, and Dec., 1879, but I think we may assume that the large difference between the two calculations for the 1st Jan., 1880, is partly due to small outstanding errors of the new tables.

Mr. Gill: I think in connection with this difference between the tabular places of Bouvard and the observations at Greenwich, there are some curious points which have been raised by Le Verrier. It was found that there was a difference of about 4″ between

the places of the planet, as given by Le Verrier's tables, and the actual places as observed at Greenwich. The tabular errors of Le Verrier's tables were also confirmed, in precisely the same amount, by observations at Paris, and after the fullest consideration of the matter, Le Verrier arrived at the conclusion that either the laws of gravity were wrong, or that the observations both at Paris and Greenwich were wrong, and he came to the conclusion that owing to the presence of Saturn's rings, and the consequent difficulty of observing transits of the limb of the ball, it was more probable that the meridional observations were wrong than that the tables were wrong. I hardly think that so very large a discordance between the actual places and the observed places is likely to exist with meriodional observations, and it is to be regretted that some independent method of determining the position of Saturn is not devised, such as heliometer measures between the planet and stars, which would be independent of any such errors, because the distance of the centre of the planet could be derived from measures of the distance of stars from the extremities of the ring and from the limbs without the possibility of an error larger than a fraction of a second of arc.

Mr. Neison: There is one thing which may be said with regard to Le Verrier's remarks, viz., that he omitted to take into consideration what are called the terms of long period with regard to both Saturn and Jupiter. These make a difference of two or three seconds of arc for Mars. But Le Verrier omitted them, on the hypothesis that they were insensible. But they have been shown not to be insensible for Mars, and if they are not insensible in the theory of Mars they will not be insensible in the theory of Saturn and Jupiter, and therefore it is quite possible that there may be terms of perhaps 20 years for these large planets, which may produce sensible irregularities, which have never yet been calculated.

Mr. Neison was then called upon to show a diagram of the lunar region about Hyginus. He said: I have to bring before the Society to-day something which is perhaps more generally interesting than the usual run of my communications. At the last meeting Lord Lindsay read a paper in which he drew attention to some remarkably sudden changes which take place in the appearance of the surface of the moon, when seen under very low illumination. The paper is not yet published, but so far as I can see the report in the *Astronomical Register* expresses very much what was said. This is the report: "Lord Lindsay showed a series of drawings of the area about the lunar crater Hyginus, from which it appeared that many small craters and markings upon that part of the lunar surface are only visible for a very short

time when near the terminator. He showed drawings which had been made by Dr. Copeland *by way of caution to those observers who seem inclined to consider that because a crater or lunar marking had not been noted before, it must therefore be a new formation.*" I think that this puts rather an incorrect interpretation on what a selenographer would call a new formation. Nobody who is in the habit of looking at the moon would say that because they saw an object for the first time it must be a new formation. Near the terminator everybody knows that there are to be seen a great many such objects, which appear and disappear very rapidly, but they are not in the habit of regarding them as new formations on the surface of the moon. I have here a drawing made on rather a large scale, showing the surface of the moon all round the lunar crater Hyginus. Some of the smaller details are made rather more distinct than they really are. It shows a considerable number of small ridges and objects, and is drawn from my own observations made in 1874 and 1875. The small ridges running across are low objects, probably not more than 30 or 40 feet high, and perhaps three or four miles broad, so that the slope must be very gentle; but when these objects are seen close to the terminator they cast a shadow for an hour or two before sunset. A person for the first time seeing such a shadow might say, "There is a great black crater," whereas in fact they would be looking at a dimple on the surface. Those well accustomed to study the moon know these appearances well, and would never dream of taking any account of any changes of the kind, knowing that at sunset everything alters in appearance. In this case we have a new crater appearing in a part of the moon which has been attentively studied and drawn 10 times by Schröter, a similar number of times by Lohrman, and on 15 occasions by Schmidt, They observed it attentively; all these little hills and ridges are given by them, and they all pretty well agree in what they saw, but though they saw several small craters they saw no large crater such as I am about to show. A year ago a German astronomer who had frequently observed this region thought one night that he saw something extremely exceptional, which he had never seen before—a large black crater, which he described as nearly as big as this. [Here Mr. Neison pinned a black cardboard representation of the new crater upon his drawing.] He watched again the following month, and saw it again, and he looked at the third lunation, and saw it so clearly that no one could overlook it. Then he wrote to Dr. Schmidt, and asked him to look out for it. And Schmidt looked out for it and writes, "Yes, there it is; I have never seen it before. How is it that we see it now only for the first time? It is there in the most conspicuous manner,

it must be something new." For my part I have observed this region in 1874, 1875, and 1876 with great care, and I never saw the crater. When I heard of it I thought there must be some mistake, but on hearing that more than one person had seen it, I came to the conclusion that if there was such a large black crater there it must have been formed since I observed the district. I have not seen it, and to this day I have not seen it. Some astronomers say, "It is there," but I cannot say it is. All I say is that if it is there it is new. Now there have been objections raised to such a course of argument. There are two classes of astronomers, one class say there is no new crater. Mr. Proctor, for example, says, "There is no new crater there, for I can see one where Klein's crater ought to be in the photographs of 10 or 15 years ago." There is another class who, for a different reason, say that it is not new. They say it is not new because it does not exist there now. (Laughter.) It is rather hard to reconcile these two classes of criticism. My evidence only goes to show that if there is a deep crater three miles in diameter there, it must in all probability be new. You see on this drawing small details which are very difficult to see without a good telescope, and it is not likely these would have been drawn and yet a large object in their midst should have been overlooked.

Mr. Common: What age was the moon when that drawing was made?

Mr. Neison: It represents the region 12 hours before sunset.

Mr. Common: We have had several diagrams showing the crater very much nearer the two small craters above. This is the first time I have heard that it was near the spiral mountains. I have been given to understand that it was half-way between Hyginus and the spiral mountains of Mädler.

Mr. Freeman: I should like to ask what is the comparative height of the central portion of the ridge of mountains appearing on the drawing with a sort of ring in the middle. Is the ring in the middle higher than the ridges surrounding it, because I think there is a possible explanation of the appearance, if the central ring is loftier than the ridges around?

Mr. De La Rue: I should like to ask whether this new crater is visible in Mr. Rutherfurd's photograph which hangs against the wall? There may be a possible explanation of its being in the photograph, and yet not being seen. For example:—At the time of the eclipse in 1860 there was one very high prominence —"the bomerang"—which was perfectly invisible to all the observers, and yet was photographed by me. A slight difference of tint may be delineated by the actinic rays and still the object may not be visible to the human eye. With a different

sensibility to particular rays, one person may see an object while another may not. It is as well to take into consideration all these possible contingencies.

Mr. Christie, after describing the difference between the various drawings and a photograph taken by Mr. Rutherfurd, said: I found a great difficulty in finding out what is the position of this supposed new crater. In Dr. Klein's map it is not quite as Mr. Neison has placed it, and in the photograph of Mr. Rutherfurd there is a bright spot shown at that place, which has a dark shadow on one side of it. Indeed, there are two such spots which might agree fairly well with Dr. Klein's crater. Dr. Klein in his diagram does not draw the crater anything like so large as Mr. Neison has represented it.

Mr. Bidder (producing a section of Dr. Schmidt's map) said: That if the drawing of Mr. Neison accurately represented that part of the moon, the map certainly did not; and he asked whether it was possible to reconcile the two.

Capt. Noble: When the announcement of Dr. Klein's discovery was first made, I examined this region of Hyginus in order to see if I could detect signs of the new crater, but I failed to do so; and I let the matter drop until I had a communication from Mr. Birt, who asked me if I would look at the moon again and make a drawing, which I did on the 2nd of November. Mr. Birt used the materials I sent him for an article in the *English Mechanic*, and I am compelled to refer to that paper for the details I supplied him with. It seems that on the 2nd of November I made a drawing of the whole of this region, and I am bound to say that, though I very carefully looked for it, I failed entirely to see a glimpse of the crater. I made one observation which may be of a certain amount of value. Running the micrometer wires over these rills and small craterlets I measured the angles subtended by some of them. (Capt. Noble then mentioned some of his measures, which did not seem to correspond to Mr. Neison's drawings.) I happened to be writing to Mr. Ward, of Belfast, (the man who saw with his wonderful eye the two satellites of Uranus with a $4\frac{3}{10}$ telescope) and I asked him if he would look at this region in the moon and communicate the result to me. He wrote me giving his measures, and I sent on his letter to Mr. Birt which he has also utilised. Mr. Ward gives some details which are exceedingly interesting, inasmuch as they enable anybody to check at once his observation of this crater. At all events, there are great discrepancies between the drawings, and I have failed to see anything like the new crater myself.

The President: I think the Society will be thankful to Mr.

Neison for having brought this matter forward. I do not feel as crushed as I expected to be when Mr. Neison got up; indeed, I think Mr. Neison has rather added to the force of what I said, viz., that great care should be exercised by anybody who thinks he has found a new feature on the moon. (Hear, hear.)

Mr. Gill suggested that Mr. Neison should have told the Society what he had himself seen instead of what other people had seen. He supposed that Mr. Neison had looked for the crater when it was under favourable conditions of illumination; and asked why some positive evidence had not been brought forward by Mr. Neison.

Mr. Neison replied to Mr. Gill, that he had taken every opportunity since last April to try and see the crater, but the sky had been too cloudy for the purpose except on one night in August, and then a shadow came over the place where the new crater ought to be. In regard to Mr. Ward's measurements, he (Mr. Neison) had calculated where the new crater ought to be according to them, and it came within an eighth of an inch on his diagram of the place where he (Mr. Neison) had put it. Capt. Noble in placing the crater in another part of the drawing had forgotten the large scale of the drawing. With regard to the height of the mountains and the ring; the ring was lower than the surrounding ridges. The ring was about 500 feet high, and the surrounding ridges about 1,000 feet. Mr. Bidder had drawn attention to Schmidt's map, but that map had been reproduced in a very imperfect manner, small objects having been reproduced as conspicuously as large mountains. Capt. Noble had looked for the crater on November 2, the same night as Mr. Pratt and Mr. Baxendale had seen it, and yet he did not see it as they did. With regard to Lord Lindsay's paper—or rather the report of it—he did not wish to reply to the paper itself, but simply to point out that such sudden changes of appearances as were referred to were no more than might be expected by anyone accustomed to observe the moon.

Dr. Wentworth Erck was called upon to explain a new bichromate battery, which he said gave a current as strong as a Grove's cell. The internal resistance was less and the current was constant. This, however, could be increased or brought down to a Daniel's cell, and it was under perfect control, and always ready at a moment's notice. Another peculiarity was the extraordinary extent to which he could dilute the bichromate solution, and yet get a strong current. The solution might be supplied at the rate of six ounces per hour. It was allowed to flow past a zinc plate, placed in a leaden trough having carbon sides.

Mr. Gill asked whether polarization was prevented.

Dr. Erck: With a flow of six ounces per hour the polarization is practically nothing.

Mr. De La Rue asked what test had been made of the constancy of the current.

Dr. Erck replied that he had tested it with a tangent galvanometer, but if the flow was stopped it did not remain constant.

Mr. Ranyard asked whether a considerable alteration in the rate of the flow made only a small difference in the intensity of the current.

Dr. Erck: The strength of the current varies with the strength of the solution. But only very slightly with the rate of flow.

Mr. Ladd said as far as his experience went bichromate cells were far from being constant. He found the most constant cells were those which held a good deal of solution with considerable depth below the plates.

The President said his experience had led him very much to the same conclusion as Mr. Ladd had arrived at, and he had given up the use of bichromate batteries. At the same time he understood that with the solution constantly changed, as was done in some laboratories in Germany, by having the battery on a shelf with a dripping bottle above, the battery may be kept moderately constant.

Dr. Erck replied that if Mr. Ladd had no experience with his form of battery, his experience with other cells had nothing to do with the question. With regard to having a great quantity of solution below the plate, in some experiments he had a depth of 14 inches, and had found it would not do, because the sinking of the deposits was counteracted by the heat which stirred them up from the bottom.

Mr. Ranyard read a note by Prof. Asaph Hall *On Hyperion, the satellite of Saturn.* Prof. Hall intends to make a special study of the perturbations of this satellite. Owing to the eccentricity of its orbit, and its near approach to Titan, he hopes to be able to determine from a discussion of its perturbations a better estimate than has hitherto been obtained of the mass of the rings.

Mr. Plummer said he wished to make some remarks with reference to the discussion which took place at the last meeting with regard to the phenomena observed when stars are occulted by the moon. About 50 years ago Sir James South read a paper before the Society in which he carefully examined all the cases of projection of stars upon the moon's limb, and he discussed the hypotheses then current as to the explanation of the phenomenon. He thought that Sir J. South had succeeded in exploding them all, but in spite of that some one or other of these exploded hypotheses were again and again brought forward to explain what

has been seen. At the last meeting one observer referred to the colour of the stars as being the cause of projection. That is one of the hypotheses which Sir James South investigated, and threw away as utterly hopeless. Then there was the hypothesis which was referred to by Mr. Gill, namely, that the star disappeared at the portion of the moon's limb where there was a deep valley, and that together with the refraction of the lunar atmosphere might cause a projection upon the limb. In order to dismiss this hypothesis it was only necessary to say that it would be extremely strange if a valley always happened to be in the right position on the limb. He had considered the subject for some years, and his theory was that the apparent projection upon the limb might be accounted for by refraction of the light through a lunar atmosphere. The moon's surface would become heated, and the light from the star might be refracted under circumstances somewhat analogous to those which exist when a mirage is seen. The lunar limb would thus appear to be raised above its real place, and the star would appear to enter the limb. This would account for a projection which he had on one occasion observed at the dark limb.

Mr. Dunkin said: I rise merely to make a remark on the observation of Mr. Plummer, which is really a very important one, for he speaks of a star projected on the dark limb. I can hardly understand how this is possible. As an old observer I have watched many occultations on the dark limb as well as at the bright limb; but I have never been fortunate enough to see anything of the kind either when the dark limb has been invisible or when it has been illuminated by earth shine.

Mr. Plummer: The observation of such a projection on the dark limb is by no means unique; a similar projection is mentioned by Sir James South fifty years ago.

Mr. Ranyard said he could not understand Mr. Plummer's theory. If there were any mirage phenomena within the lunar atmosphere they would be much fainter than upon the earth, for the intensity of a reflected image is proportional to the difference of the refractive indices of the media at the bounding surface of which the reflection takes place—mirages upon the moon would not, therefore, be comparable in brightness with terrestrial mirages.

Mr. Christie: With regard to the projection on the bright limb of the moon, there is no difficulty in explaining such projections on the theory of the Astronomer-Royal; but with regard to the dark limb I fail to see how Mr. Plummer's mirage theory can possibly explain the projection, because the dark limb is not heated, and there could therefore be no abnormal heating of the atmosphere.

Capt. Noble said he could not help thinking that the excellence of the telescope had a good deal to do with the phenomenon observed, and that personal equation also has something to do with it. He had observed a great many occultations, and never in his life saw a projection on the moon, either at the bright or dark limb. He had, however, observed a star disappear and reappear at a point where there were inequalities on the moon's limb.

Mr. Plummer said in reply: I am afraid I misled Mr. Ranyard. I did not intend to speak of reflection when I said the phenomenon was like a mirage. The cause of the phenomenon I should have said—that is, the heat of the surface—produces a difference of refraction, not of reflection. As to Capt. Noble, I can only recommend him to read Sir James South's paper, for he has brought forward two of the hypotheses which Sir James has demolished.

Mr. Downing read a paper *On the Reduction of North Polar Distances of the Melbourne Catalogue*.

Mr. Gill: I wish to remark with great emphasis upon the important work Mr. Downing is doing. No one can read his last paper without seeing the great labour and care he is bestowing. It is only those engaged in such reductions who can appreciate his work. It bears upon a matter which is of the highest importance, namely, upon the tables of refraction now in use. In the last Greenwich annual catalogues we have a correction to Bessel's refractions which seems to be doubtful. The tendency of these discussions is to encourage the belief that the old tables were nearer the truth.

Mr. Christie said: I agree with Mr. Gill as to the importance of Mr. Downing's work. With regard to this question of refraction; I think Mr. Gill is a little anticipating in speaking of the last Greenwich catalogue. The old refractions are used up to 1868. I quite admit there are certain discrepancies between the different catalogues, which suggest a cause of anxiety as to astronomical refraction, but that is a question which can only be settled satisfactorily by referring to the southern observatories, because there are difficulties about the observations of circum-polar stars which make it difficult to deduce the refractions with absolute certainty, so that Mr. Downing's discussion is very valuable. Both his papers seem to show that the old refractions, as used in the first seven-year catalogue, and also in the second seven-year catalogue, sensibly represent the observations made in the southern observatories at the Cape and at Melbourne, and that seems to me a very important matter.

The meeting adjourned at ten o'clock.

REVIEWS.

Ueber Schmidt's neuen Stern im Schwan. By Dr. Oswald Lohse. Reprinted from the *Monatsbericht der Königl. Akademie der Wissenschaften.* Berlin. 1878.

The remarkable variable star in Cygnus (R.A. 21h. 36m. 50·41s., N.P.D. 47° 43′ 21″·5 —1876·0) was first observed by Dr. Schmidt in Athens at about a quarter to six on the evening of the 24th Nov. 1876. He described it as very yellow and rather brighter than η Pegasi—that is, as being of about the third magnitude. After the evening of the 24th the star appears to have remained about the same brightness till the 27th of Nov., and then to have diminished very rapidly.

The star was not observed by Dr. Lohse till the 5th of Dec., 1876, when he examined its spectrum with a direct-vision star spectroscope upon the Berlin 9-inch refractor. The spectrum consisted of seven bright lines upon a background of continuous spectrum in which were broad absorption bands. By far the brightest line was one in the red. Dr. Lohse identified this line with the C of the hydrogen spectrum. Above the C line was a broad dark space and there was a similar dark absorption band, or interruption of the continuous spectrum, above the A line, which he refers to as the F line.

Owing to a continuance of bad weather the spectrum was not again well observed till the evening of the 14th December. The brightness of the star had in the meantime decidedly decreased, but the same bright lines were seen standing out with rather greater contrast on the continuous spectrum than on the 5th of Dec., and the absorption band in the blue appeared rather more striking than before, by reason of its intense darkness.*

On the 23rd of Dec. there was about half an hour of clear weather, and the star was again observed. Judged of by the neighbouring stars it seemed not to have decreased in brightness, but the spectrum showed the same bright lines, apparently fainter, and the continuous spectrum seemed decidedly fainter than before.

On the 26th Dec. the red line appeared to again decrease in brightness, and the absorption bands seemed also to have increased in breadth and darkness. On the 27th Dec. Dr. Lohse estimated the magnitude of the variable to be 6·6.

On the 1st of Jan., 1877, the star had but slightly decreased in magnitude, but the brightness of the red line had greatly decreased, and the continuous spectrum below the red line had entirely disappeared. The red line consequently appeared isolated from the rest of the spectrum, by the absorption band above it. The absorption band in the blue was also still very marked.

During January and February the decrease in brightness was not continuous, but on the whole the lines towards the red end of the spectrum appeared to fade most rapidly.

On the 1st of March. Dr. Lohse estimated the magnitude of the variable as 8·5 only, three bright lines were then visible in the spectrum, of which the brightest was the nitrogen line in the blue.

The observations of Dr. Lohse do not continue beyond the 1st of March, 1877, but it will be remembered that on the 2nd of Sept., 1877, Lord Lindsay, observing with his 15-inch achromatic at Dun Echt, found that the continuous spectrum and all the bright lines but one had disappeared. On carefully determining the wave length of the remaining line, it was

* Durch ihre intensive Dunkelheit bemerklich.

found to coincide with the well-known nebula line ·0005004 *m m*. Since Sept., 1877, there has been no other outburst of bright lines, and the star still gives a single bluish monochromatic image.

Certain theorists frequently refer to the red stars as if there could be no doubt that they were cooler than blue and white stars, but the above observations show that after a gaseous outburst a star may cool down from red to blue. The general law, confirmed by Schmidt, Birmingham, and Webb (all of whom have paid special attention to red stars), is that the red variables (and most of the red stars seem to be variable) grow paler as they increase in magnitude, and become more ruddy as they again decrease towards their minimum. There appears, in fact, to be no connection between the colour of a star and its age in the universe, and the assumption which has recently been made with regard to the breadth of the calcium line in the spectrum of Vega, corresponding to a higher temperature than the solar temperature, is probably quite groundless.

Six Months in Ascension: an unscientific account of a scientific expedition. By Mrs. Gill; with a map. London: John Murray, Albemarle Street. 1878. pp. liv. 285. 9s.

In the introduction Mr. David Gill gives a good popular history of the attempts to determine the sun's distance from Aristarchus to the present time. The final result of his own very successful observations of Mars at Ascension is looked for by astronomers with much interest. The reductions, we learn, are far advanced, and they promise a result of very great accuracy. The companionship of his wife, besides contributing in various ways to the success of the expedition, has been the means of our possessing an account of all its details of very considerable interest, both to star-gazers, and those who are little informed of the many curious things to be seen in this little volcanic island, with its area of 38 square miles, and no land nearer than St. Helena, 800 miles off. A chapter is devoted to St. Helena—one of our own memories of bygone days—where a little of the debris of Halley's observatory still remains, and that of Johnson, now the artillery mess-room, might suggest a parody of the lines of the Persian poet on the vicissitudes of human affairs:

"The spider holds the veil in the palace of Cæsar,
The owl beats the kettle-drum on the dome of Afrasiab."

For now—

Wine-glasses and decanters have replaced the transit,
Billiard balls rattle beneath the dome of Johnson.

The governor of St. Helena, Mr. Janisch, a descendant of Encke, the well-known German astronomer, and himself an enthusiastic amateur in astronomy, gave a cordial welcome to Mr. and Mrs. Gill; and at Ascension Captain Phillimore, the naval commandant, supreme in the island, was very kind and useful. The observatory was finally established in a little harbour named by Captain Phillimore "Mars Bay," an interesting spot to any astronomer who may hereafter visit Ascension, as the place where Lord Lindsay's fine heliometer under the skilful management of Mr. Gill did such good work. Here is a description of the heavens on a fine night:—"Sitting that first evening after sunset in the verandah which looked upon our novel croquet lawn, we could speak of nothing, think of nothing, but the beauty of the heavens. Though Ascension was barren, desolate, formless, flowerless, yet with such a sky she could never be unlovely. The stars shone forth boldly, each like a living fire. Mars was yet behind Cross Hill, but Jupiter literally blazed in the intense blue sky now guiltless of cloud from horizon to zenith; and thrown across in graceful splendour, the Milky Way seemed like a great streaming veil

woven of golden threads and sparkling with gems. The Southern Cross —a poem in the heavens—shone out a bright welcome to us, while our old friend the Great Bear still kept faithful watch in the north over our wanderings. How strengthening and restful, after fatigue and petty worry, is such an hour! One forgets to be careful and troubled about many things, and the soul trembles with its load of love and gratitude to Him who 'made the stars also.'" (p. 56.)

The following is an account of the work on the critical night of the opposition:—"I now took the watch for the morning. The first hours of my waiting promised well, but before 1 a.m. a tiny cloud, no bigger than a man's hand, arose in the south, and I called my husband to know what he thought of it. On this, the night of opposition, the planet would be in the most favourable position for beginning morning observations about 2.30. Now it was but 12.50, and the question came to be—shall some value of position be lost, so as to give a greater chance of securing observations before the rising cloud reach the zenith, or shall we wait, in the hope that this cloud has 'no followers'? Being a Scot, and fully appreciating the motto of the Kirkpatricks, 'I mak siccar,' David began work at once in a break-neck position with the telescope pointed but a few degrees west of the zenith. How my heart beat, for I saw the cloud rise and swell, and yet no silver lining below. I dared not go inside the observatory, lest my uncontrollable fidgets might worry the observer, but sat without on a heap of clinker, and kept an eye on the enemy. Five, ten, fifteen minutes! when David called out, 'Half-set, finished—splendid definition - go to bed!' Just in time, I thought, and crept off to my tent, thankful for little and not expecting more, for one arm of the black cloud was already grasping Mars. My husband would, of course, remain in the observatory for the rest of the night to watch for clear intervals, while I was expected to go to sleep. But how could I? I took up a book and tried to read by the light of my lantern for a few minutes; then I thought to myself, 'Just a peep to see whether the cloud promises to clear off.' I looked forth, and lo! no cloud! I rubbed my eyes, thinking I must be dreaming, and pulled out my watch, to make sure I had not been asleep, so sudden was the change. No! truly the obnoxious cloud had mysteriously vanished, and the whole moonless heavens were of that inky blueness so dear to astronomers. Mars now outrivalled Jupiter in ruddy splendour; Orion had flung abroad his jewels like hoar-frost; the Pleiades glittered in such bewildering multitude, that it seemed as if the lost Pleiad had returned with a train of shining followers from some other system. 'Like fire-flies tangled in a silver braid,' they shone with a soft beauty; and everywhere, above and around, myriads of stars dazzled the sight.

"While my eyes drank in this beautiful scene, my ears were filled with sweet sounds issuing from the observatory, 'A, seventy and one, point two seven one; B, seventy-seven, one, point three six eight,' &c. Let not anyone smile that I call these sweet sounds. Sweet they were indeed to me, for they told of success after bitter disappointment; of cherished hopes realised; of care and anxiety passing away. They told too of honest work honestly done—of work that would live and tell its tale, when we and the instruments were no more; and, as I thought of this, there came upon me with all their force the glowing words of Herschel—'When once a place has been thoroughly ascertained, and carefully recorded, the brazen circle with which that useful work was done may moulder, the marble pillar totter on its base, and the astronomer himself survive only in the gratitude of his posterity; but the record remains, and transfuses all its own exactness into every determination

which takes 'it for a groundwork.' Happier hours I never spent than those early morning ones under the beautiful heaven; for in helpless restlessness I had again taken up my position on the clinker. The night was unusually still, and outside the observatory there was not a sound save the gentle flapping of the tents—like the wings of passing birds, and the continual murmur of greeting from the waves as they met the shore. Time passed unconsciously, for I was giving my imagination full play, and when I heard the observatory dome shut, I could hardly believe that I had been dreaming on a rock for three hours. The awakening was as pleasant as the dream had been. David was radiant, and no wonder! All our previous disappointments, fatigue, and anxiety were forgotten in the good fortune of to-night, and now we might rest."

Irrespective even of astronomy, this is a very pleasant and entertaining book (we only wish it had some illustrations); its readers, and we trust they will be many, will enjoy the sparkling narrative, and will feel obliged to the amiable and accomplished Scotch lady whose pen, dipped as it were in the phosphorescence of the ocean, so vividly brings before us the incidents of human life and the marvels of nature in a strange and distant island.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

To all communications must be annexed the name and address of the sender, as a guarantee of good faith.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

NAMES OF MARKINGS ON MARS.

As Mr. Ranyard refers to the names in my chart of Mars, I may as well mention that they were given for my own convenience only. I drew a chart of Mars in 1867, to illustrate a work I was then writing. Knowing I should want to refer to different features, I gave names to them; letters would not have suited my purpose.

I suppose there is some meaning in Mr. Sadler's remark about the "social" aspect of "the plan of christening continents, &c., and its unfairness as anticipating the verdict of posterity," but I do not know what that meaning is; nor can I fathom the significance of his humorous remarks (at least, I suppose they are humorous) about putting a price on the Martian continents and seas. It certainly has never occurred to me that any one would either be in the least pleased at my attaching his name to a Martian feature, or in the least concerned because I did not happen to do so.

There is nothing to prevent those who observe Mars in a practical way—not many, I fear—from using letters or numbers, or any other method of indicating the planet's features which may seem good to them. My nomenclature, as amended by Mr.

Green, suits my own purpose very well. If another plan equally convenient comes into vogue, I can readily adopt it. At present, however, I have reason to believe that thousands more of those whom I address have become familiar with my names than are likely even to hear that other methods of nomenclature have been proposed. But I do not ask any one to adopt names which I only invented for my own convenience. It would not be reasonable.

January 2, 1879. RICHD. A. PROCTOR.

NOMENCLATURE OF MARTIAL MARKINGS.

Sir,—I am glad to see in your last number that you seek for opinions of your correspondents upon the best method of naming the objects which may be observed on the planet Mars.

It is a great pity that the nomenclature of Mädler (1830) has not obtained more support. Mr. Ranyard in his letter points out that since that time Kaiser, Proctor, Terby, Flammarion, and, lastly, Schiaparelli, have in their turn named and re-named the salient features of the planet. I would suggest that we return to the method of Mädler, which was continued by Kaiser in 1862, namely, to designate the markings by the letters of the alpbabet in capitals, subdividing these by small letters where necessary. This principle of notation, as Mr. Marth says, is the most simple and the most practical.

Failing this, let us have recourse to the Mythological Dictionary, and if we are careful to select the names of male characters we shall not be intruding on the property of the Minor Planets.

The system which now obtains is the worst possible.

The markings on a planet are international scientific property, and the instances we have on earth, such as Smith's Sound, Hudson's Bay, &c., cannot hold good, the world being in such cases content to accept the nomenclature of a nation, as defining a certain portion of its possessions.

To sum up, then, I think that whatever system is adopted, it would be well that it should be done with unanimity on the part of astronomers: let us have the adhesion of Germany, France, Russia, Italy, and America, and then there may be some certainty as to the success of the nomenclature.

Haigh Hall, I am, Sir, your obedient servant,
Wigan: 79.01.17. LINDSAY.

Dear Sir,—I hasten to reply to your letter, and give you my opinion on the subject of the nomenclature of the spots on Mars. I do this as briefly as possible, in order that my letter may reach

you in time for the February number. My views chiefly relate to the most useful course to follow, in order to promote the advance of areography. 1. The chart of Mars is yet only in outline, and the time is not yet come for adopting a definite nomenclature. An entirely new nomenclature of any sort would only create confusion in the study of the planet, of which we have still only a rough draft. 2. In this view it would be well to confine ourselves as much as possible to the names, *unfortunately too numerous*, which already exist, excepting the addition of some which might be judged *necessary*. 3. Whilst still adopting the nomenclature of Mr. Proctor, as provisional, with such modifications as are absolutely necessary, we should be occupied *exclusively* at present in the preparation for the study of the planet in 1879, and in clearly determining the doubtful points arising from the preceding oppositions. This preparatory study is unhappily at present very far from being advanced, attention having been diverted from it by the question of charts and names.* 4. We must apply ourselves above all to verify the *positive* observations of M. Schiaparelli, whose chart if it were verified would constitute the greatest step made by areography for many years. 5. I embrace this occasion for earnestly inviting M. Schiaparelli to continue without intermission his observations during the future oppositions, in order to enable him to complete his study in what relates to the *northern* regions of the planet.

Louvain: Yours truly,
Jan. 20, 1879. Dr. F. TERBY.

A PLEA FOR OLD NAMES.

Dear Sir,—Having read the letters in your January number, recommending a new system of nomenclature for the markings on the planet Mars, I desire to make an earnest protest against change. The present names have been in use for many years, they are to be found freely in the publications of the Royal and other astronomical societies, and have been accepted by a large number of workers at the Martial surface.

There may be a variety of opinions as to the propriety of employing the names of living observers, but names of some kind are a great convenience, and serve the purpose of identifying the various portions far better than any resemblances, numerals, or letters, that could be devised.

* Note.—If the greater part of the observers had been willing to manifest the same confidence in me after the opposition of 1877, as before, by communicating to me their observations, I would have prepared a list of doubtful points for 1879, as I did for 1877. It is doubtful whether such a work can still be done before the next opposition.

No one will argue that the names Schröter, Laplace, Kaiser, &c. are unsuitable, but some may prefer that no names, however closely connected with the advancement of the theory, on the delineation of the surface should appear, but an objection to the use of names, as opposed to the custom or spirit of astronomy, is utterly untenable after their profuse employment on the maps of the moon.

The names Kaiser Sea, De La Rue Ocean, or Dawes forked bay, are as familiar as household words to those who employ either pen or pencil in this cause, and an affection for old names is at least an excusable weakness. I would rather call the Kaiser Sea by the name of that eminent astronomer and admirable draughtsman than by any set of numerals or X Y Z's that could be invented. And as to Dawes' forked bay, it was the special wish of that keen-sighted lover of the telescope that his name should be connected with the discovery of its duplicate character, considering it rather a feat of seeing, even for his well-trained eye, and Dawes' forked bay it will ever be to me, and I trust to all who respect his memory.

Regretting that various maps and different names should exist, I take this opportunity of objecting to any increase in their numbers.

I remain, dear Sir, yours very respectfully,
NATHL. E. GREEN.

LUNAR OBJECTS FOR JANUARY.

As suggested by Mr. Birt, I have lately carefully observed the light streaks from Proclus. I was able to trace two of the main streaks to the outside of the walls, the others took their rise from a circular gray border surrounding the crater. Their direction, though not always straight, did not appear to be disturbed by objects on the Mare Crisium. In two instances a bend was observable, once when passing between two craters, once when passing hilly country, also one streak terminated at Picard.

I shall be glad to receive communications from other observers.

The Lodge, Clapham Road, Bedford. T. P. GRAY.

JUPITER'S SATELLITES.

Sir,—For the past two-and-a-half opposition periods I have been carefully watching the relative brilliance of these little bodies, and during that period have made observations on 200 occasions, obtaining 175 of I., 180 of II., 192 of III., and 191 of

IV. Accepting the sizes (measured) which have been obtained by others, the results are briefly as follows:—

Relative mean brightness	.....	III., I., II., IV.
,, ,, reflective power	...	II., I., III., IV.
,, ,, variability	.....	IV., II., I., III.

Entering more into detail I will take each satellite separately and in order.

SATELLITE I. is decidedly brightest in the W. inferior quadrant; there is very little difference between the other three quadrants which follow in succession E. —, E. +, and W. +. It appears to be least variable in the W. + quadrant, and most in the E. —. The phenomena relating to the appearance of this satellite seem to be gradually retrograding round its orbit, as if it revolved on its axis in a period a very little less than its orbitual revolution.

SATELLITE II. is decidedly brighter in the E. than in the W. part of its orbit, the relative brightness of the four quadrants being E. —, E. +; W. +, W. —. It is very variable in all parts of its orbit, especially in the E. inferior.

SATELLITE III. is decidedly brightest in the E. +, and faintest in the E. — quadrant. It is most variable in the E. +, and least in the W + quadrant.

SATELLITE IV. is much the brightest in the W· + quadrant, the brilliance increasing successively through E. +, E. —, W. —, to W. +. This is by far the most variable satellite, seeming sometimes less than 10 mag., and at others more than 6 mag., but there seems very little, if any, difference in this respect among the four quadrants.

In the above the sign + and — invariably indicate superior and inferior respectively.

On one occasion II. in the E. — quadrant much surpassed the mean brilliance of III., whilst on another III. in the W. — quadrant was lower than the mean of II.

It will be noticed that there are some differences in these results as compared with those published in the *Comptes Rendus*, July 19, 1875, by M. Flammarion.

FRANK C. DENNETT.

10, Terminus Terrace, Southampton:
Dec. 16, 1878.

Erratum in Jan. No.—Page 22, line 25, for *Sepalius* read *Sempilius*.

Books Received.—London Science Class Books—Practical Physics—Elementary Geography. Longmans & Co. 1879.—Annuaire de l'Observatoire de Bruxelles pour l'année 1879. Bruxelles. 1878.—Bibliographie, &c., de Spectroscopie. Ch. Fiévez. Bruxelles: F. Havez. 1878.

ASTRONOMICAL OCCURRENCES FOR FEBRUARY, 1879.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sat	1		Sidereal Time at Mean Noon 20h. 45m. 16·98s.			Capella. —
			Sun's Meridian Passage 13m. 49·69s. after Mean Noon			8 21·1
		14 11	Near approach of 125 Tauri (6)			
Sun	2	5	Conjunction of Mars and 4 Sagittarii 0° 4′ S.	the Sun.		8 17·2
Mon	3	14 22	Near approach of B.A.C. 2154 (6½)	to		8 13·3
		7 35	Occultation of 58 Geminorum (6)			
Tues	4	8 10	Reappearance of ditto	ness		8 9·3
		13 51	Occultation of θ Cancri (6)			
Wed	5	14 53	Reappearance of ditto	near		8 5·4
		13 41	☽ Full Moon			
Thur	6	6 6	Near approach of π^1 Cancri (6½)	his		8 1·5
		14 58	Near approach of B.A.C. 3529 (6)			
Fri	7	15 27	Occultation of 43 Leonis (6)	through		7 57·5
		16 27	Reappearance of ditto			
		14 55	Occultation of p^5 Leonis (5)			
Sat	8	15 41	Reappearance of ditto	invisible		7 53·6
		3	Conjunction of Jupiter and Sun			
Sun	9		Saturn's Ring : Major axis=36″·66 Minor axis= 2″·47	satellites		7 49·7
Mon	10					7 45·7
Tues	11			Jupiter's		7 41·8
Wed	12					7 37·9
		6 53	☾ Moon's Last Quarter			
		15 41	Occultation of 4 Scorpii (6)			
Thur	13	16 15	Reappearance of ditto			7 33·9
		16 57	Occultation of π Scorpii (3)			
		17 48	Reappearance of ditto			

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Fri	14		Illuminated portion of disc of Venus=0·959 Illuminated portion of disc of Mars=0·935			Capella. 7 30·0
Sat	15		Sidereal Time at Mean Noon 21h. 40m. 28·758.	Sun.		7 26·1
Sun	16	12	Conjunction of Moon and Mars 1° 47′ N.	the		7 22·1
Mon	17		Sun's Meridian Passage 14m. 14·50s. after Mean Noon	to		7 18·2
Tues	18			nearness		7 14·2
Wed	19	22 23 23	Conjunction of Jupiter and Mercury 1° 28′ S. Conjunction of Moon and Jupiter 2° 36′ S. Conjunction of Moon and Mercury 4° 4′ S.	his		7 10·3
Thur	20	16 3 16	● New Moon Uranus at opposition to the Sun	through		7 6·4
Fri	21					7 2·4
Sat	22	13	Conjunction of Moon and Venus 5° 51′ S.	invisible		6 58·5
Sun	23	8	Conjunction of Moon and Saturn 7° 19′ S.			6 54·6
Mon	24			satellites		6 50·6
Tues	25					6 46·7
Wed	26	7 45 8 54	Occultation of 26 Arietis (6) Reappearance of ditto	Jupiter's		6 42·8
Thur	27					6 38·8
Fri	28	19 58 13 17	☽ Moon's First Quarter Near approach of χ^1 Tauri (5½)			6 34·9
MAR.						
Sat	1					6 30·9

THE PLANETS FOR FEBRUARY.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury...	1st	19 14 24	S. 22 19	5″·3	22 53·4
	9th	20 33 43	S. 20 30	5″·0	23 13·1
	17th	21 26 49	S. 17 14	4″·8	23 34·6
	25th	22 21 10	S. 12 29	4″·8	23 57·3
Venus ...	1st	21 55 39	S. 14 13	10″·1	1 10·2
	9th	22 33 55	S. 10 38	10″·2	1 16·9
	17th	23 11 8	S. 6 45½	10″·4	1 22·5
	25th	23 47 37	S. 2 41	10″·6	1 27·5
Uranus ...	2nd	10 20 50	N. 11 10	4″·2	13 29·4
	18th	10 18 15	N. 11 25	4″·8	12 23·9
Neptune...	2nd	2 21 20	N. 12 12½	...	5 31·2
	18th	2 22 10	N. 12 47½	...	4 29·1

Mercury is unfavourably situated for observation, rising about fifty minutes before the sun on the 1st, the interval decreasing.

Venus sets an hour and a quarter after the sun, at the beginning of the month, the interval increasing.

Uranus will be in opposition to the sun on the 21st, and is well situated for observation.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN FEBRUARY, 1879.

BY W. R. BIRT, F.R.A.S., P.S.S.

In the list for January attention was called to the light streaks, apparently radiating from Proclus, as suitable objects for observation. In the *English Mechanic*, January 17, 1879, No. 721, p. 473, a letter appears from Mr. Dennett, in which he specifies nine light streaks, two of which he describes as being directed eastward toward Le Mourrier, another towards Taruntius A, and six westward. Of these *nine* streaks I only remember having observed *three* directed westward from Proclus. Although Mr. Dennett's description is sufficiently precise for identification, I am unable to decide exactly which of Mr. Dennett's nine are identical with the three I have seen. Those of Mr. Dennett, the directions of which come nearest to those of the three which I have observed are IV., VI., and IX., and I would suggest that during the present spring, the moon being favourably situated for the purpose, the remaining six of Mr. Dennett's should be identified.

The following are a few records of my observations of the light streaks:—

1873, April 2, 6.45 to 7.35. North streak passes between Peirce and Peirce A. [Mr. Dennett's VI. is described as passing between Picard and Peirce W. R. B.] Middle streak passes over the mountain N.W. of Schröter's *l* [E]; this mountain is *m* of Schröter. The south streak is scarcely traceable.

1873, April 3, 7.0 to 7.45. The northern and middle streaks are more decided than last night, and rather more northerly in direction; the northern streak just includes the crater Peirce A, and the middle streak is a little, but very slightly, north of the mountain *m* of Schröter. The

southern streak is directed towards Picard, it is much fainter than either of the others, it shines with about half the intensity of their light.

1873, April 10, 7.20 to 8.15. Northern streak north of Peirce. I fail to distinguish Peirce A. I did not detect Peirce A on November 1, 1873, nor was it seen on November 28, 29 or 30, nor on July 8, 1876, but it was readily seen January 20, 1877.

Middle streak passes between Picard and Peirce, about one-third the distance between the two from Picard; the south edge of Peirce is nearest to the north streak, about one-third the distance between the two streaks. The south streak is not traceable.

1877, June 16, 8.20 to 9.0. The streaks from Proclus were faint. The south streak passed over Schröter's group, *l*, *m*, *n*. The north streak passed between Peirce and Peirce A. Definition at times on the *Mare* very bad, near the terminations exquisite.

Schröter in the illustrations to his Fragments T. XXXIV., figs. 1 and 4, shows two light streaks, direction towards the west, the southern one emanating from his mountain *n*, passing to *m*, from thence passing between Picard and Peirce. Peirce A is not shown in these drawings. Picard has a slight streak emanating from it towards the *east*. The peculiarity of these drawings is that the dark tint around the two craters is of considerable extent, that around Peirce is pear-shaped, the tapering point is directed towards the east.

It does not appear from Mr. Dennett's letter that he has yet observed a streak passing over Peirce A, or between Peirce and Peirce A, which I observed on April 2, 1873, and also on June 16, 1877; on April 3, 1873, it was just on the north of Peirce A. It will be very interesting to ascertain if these streaks *always* preserve the same directions, or if the directions vary with changes of angle of illumination. Peirce A, when visible, will assist greatly to determine this question.

Neison mentions three light streaks extending from Proclus in directions N.E., N., and S. Mr. Dennett's I., II., and III. appear to have some reference to these, they are, however, very different to those I have called attention to, which are decidedly of the Messier type. There are two light streaks on the east of Proclus which border the Palus Somnii and appear to result from difference of level and changes in the angle of illumination.

VARIABLE STARS, FEBRUARY.

Approximate times of minima and maxima, according to Schönfeld and Winnecke. (Vierteljahrsschrift der Astron. Gesellschaft XIII. 3.)

1879.	Gr. h.	Star.	mag.	R.A. 1855. h.	m.	s.	Decl. °	′
Feb. 3.		T Monoc.	min. 7·8	6	17	24	+ 7	9·7.
4.	14	U Coronæ.	min. 9	15	12	17	+ 32	10·8.
—		R Virginis.	max. 7	12	31	9	+ 7	47·1.
10.	15·4	Algol.	min. 4	2	58	45	+ 40	23·6.
—	18·0	δ Libræ.	min. 6	14	53	14	— 7	56·4.
11.		T Monoc.	max. 6	6	17	24	+ 7	9·7.
—	12	U Coronæ.	min. 9	15	12	17	+ 32	10·8.
12.	6·5	S Canori.	min. 10	8	35	39	+ 19	33·2.
13.	12·2	Algol.	min.					
15.		R Leporis.	min. 9	4	53	0	— 15	1·7.
16.	9·1	Algol.	min.					
17.	17·5	δ Libræ.	min. 6	14	53	14	— 7	56·4.
18.	10	U Coronæ.	min. 9	15	12	17	+ 32	10·8.
19.	5·9	Algol.	min.					

21.		R Scorpii.	max.	9	16	9	1	— 22	35·0.
24.	17·0	δ Libræ.	min.	6	14	53	14	— 7	56·4.
26.		R Serpentis.	max.	6·7	15	44	1	+ 15	34·6.
27.		R Orionis.	max.	9	4	51	8	+ 7	54·3.
28.		R Ariet.	min.	?	2	7	53	+ 24	22·8.

SATELLITES OF URANUS.

Major and minor semi-axes a and b of the apparent ellipses described by the satellites, and position-angles p_o of the major axes:

	Ariel.		Umbriel.		Titania.		Oberon.		
1879.	a	b	a	b	a	b	a	b	p_o
	″	″	″	″	″	″	″	″	°
Feb. 4	15·22	3·36	21·21	4·68	34·79	7·67	46·52	10·26	12·95
14	15·26	3·47	21·26	4·84	34·87	7·94	46·63	10·61	12·85
24	15·27	3·59	21·27	4·97	34·88	8·20	46·65	10·96	12·76

In these apparent orbits the satellites move in the direction of decreasing position-angles, from their greatest northern elongation N. (in position angle 12°·8) to inferior conjunction (pos. 282°·8), greatest southern elongation S. (pos. 192°·8), superior conjunction (pos. 102°·8), etc. The satellites will be at these points of their orbits about the following hours, G.M.T.:

Ariel.			Umbriel.			Titania.			Oberon.		
1879.	h.			h.			h.			h.	
Feb. 1	7	N.	Feb. 2	0	N.	Feb. 1	8	sup.	Feb. 1	21	S.
2	13	S.	4	1	S.	3	12	N.	5	6	sup.
3	19	N.	6	3	N.	5	16	inf.	8	15	N.
5	2	S.	8	5	S.	7	20	S.	12	0	inf.
6	8	N.	10	6	N.	10	1	sup.	15	8	S.
7	14	S.	12	8	S.	12	5	N.	18	17	sup.
8	20	N.	14	10	N.	14	9	inf.	22	2	N.
10	3	S.	16	12	S.	16	13	S.	25	11	inf.
11	9	N.	18	14	N.	18	17	sup.	28	20	S.
12	15	S.	20	15	S.	20	22	N.			
13	21	N.	22	17	N.	23	2	inf.	Ariel.		
15	3	S.	24	19	S.	25	6	S.	22	17	S.
16	10	N.	26	21	N.	27	10	sup.	23	23	N.
17	16	S.	28	22	S.	29	15	N.	25	5	S.
18	22	N.							26	12	N.
20	4	S.							27	18	S.
21	11	N.							29	0	N.

A. MARTH.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec., 1878.
Common, A.
Dansken, J.
Dallmeyer, J. H.
Freeman, G. F.
Gilby, J.
Harris, J.
Hemming, Rev. B. F.
Lewis, R. T.
Monk, Dr.
Normand, J.
Waldegrave, Hon. H. N.

To Jan., 1879.
Tadbury, J.
Wright, Rev. W. H.

To Feb., 1879.
Brewin, T.

To March, 1879.
Gibson, J.
Locke, W.

To June, 1879.
Banks, Mrs.
McCance, J. L.
Noble, Capt. W.
Sargent, Rev. J. P.

To Sept., 1879.
Esdaile, J. K.

To Dec., 1879.
Baldelli, Contessa.
Clegram, W. B.
Clermont, Lord.
Collingwood, E.
Davies, Rev. R. P.
Ellis, W. M.
Goode, J. F.
Hall, Rev. R.
Hunt, G.
Lamb, Dr.
Lee, J.
Numsen, W. H.
Redpath, H. S.
Richards, E. M.
Richards, Rev. W. J. B.
Slugg, J. T.
Smyth, Prof. P.
Walker, G. J.
Warriner, H.

To Jan., 1880.
Hutchings, Rev. R. S.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON, 11, *Angel Court, Throgmorton Street, E. C.*, **not later than the 20th of the Month.**

The Astronomical Register.

No. 195. MARCH. 1879.

IN MEMORIAM.

With the deepest regret and sincerest sorrow we discharge the melancholy duty which has devolved upon us of announcing the decease of our old, dear, and much-esteemed friend, the originator and first editor of the *Astronomical Register*, Sandford Gorton, Esq., F.R.A.S., which occurred at his residence, Parnham House, Clapton, on the evening of the 14th ultimo. He had been for some years last past a confirmed invalid, though happily not a great sufferer, but it was too evident to those about him that his vital powers were slowly but certainly failing, until at length he died without consciousness or pain.

Always of an active and intelligent mind, he early in life evinced a strong predilection for mechanical and scientific pursuits, and astronomy soon became the principal and favourite occupation of his leisure. Soon after his marriage he went to reside at Stamford Villa, Downs Road, Clapton, where he established an observatory, constructed principally after designs of his own, and which he furnished with some high-class instruments. His principal telescope was a remarkably fine one, of 3¾-inch aperture, by Alexander Ross, mounted on a beautifully finished equatorial stand by Thomas Cooke. The telescope was, however, subsequently more completely mounted upon an equatorial stand with clock motion by Dallmeyer, a structure combining the best workmanship with high efficiency. To his instruments and observatory Mr. Gorton was constantly adding many ingenious and happy contrivances tending to the comfort of the observer and the facility of his operations, all which were much appreciated and many of which were imitated by his friends. In his observatory he became an ardent and persevering general observer, keeping an accurate record of his work. To his many other acquirements he added

that of an excellent draughtsman; his delineations of sun-spots and planetary features are consequently marked by careful execution and strict fidelity, several of which are well known to many of our subscribers, and, if we remember rightly, he presented to the Royal Astronomical Society some admirable coloured drawings of the planets Mars and Jupiter, and, we believe, of Saturn also. A plate of the planet Jupiter, from a sketch of our lamented friend, forms the frontispiece to our first volume, an inspection of which will give a good idea of his success in this pleasing and useful occupation, but his coloured pictures are far finer.

It was during his residence in Downs Road that he first and often spoke of his anxiety to establish a purely astronomical periodical, feeling sensible of its necessity, and some of his reasons he has given in the address which accompanied the first number. It occurred to him that it would be very desirable "to collect together those stray fragments of information, which though not of sufficient importance possibly to occupy the pages of the *Monthly Notices*, may nevertheless, in the shape of passing conversation, or occasional notes, be useful for future reference," he wished "to introduce a sort of astronomical *Notes and Queries*, a medium of communication for amateurs and others," believing that "many valuable contributions to the science are now scattered in different publications, collected in one periodical they would be of far more benefit to the astronomical inquirer than they are now." He was one of those, moreover, who were strongly of opinion that to the discussions and observations at the meetings of the Fellows of the Royal Astronomical Society publicity should be given, and of which some record should be preserved. Being an admirable printer, he no doubt the more readily saw his way to launch such a serial, and knew that at the outset of its career he could at all events, while it retained reasonable dimensions, materially reduce expenses by printing it himself. In January, 1863, the *Register* appeared. To it he thenceforth applied all his energies, and no slight proof of his untiring zeal is afforded by the fact that the first volume was wholly printed by himself at his own private press. The increased bulk of the periodical, however, prevented the possibility of the private printing being continued, owing to the limited time for publication; after the first volume, therefore, the printing was intrusted to Messrs. Spottiswoode. And here we cannot forbear inviting the attention of our readers to, and asking them to unite with us in admiring the general style and appearance of our first volume, for it shows, we think, a proficiency in the art of printing, and a consummate knowledge and mastery of its minute and intricate details very rarely attained by an amateur, while the indefatigable industry and prolonged exertion necessarily

involved in such single-handed work incontestably demonstrate that the publication of his serial was to him indeed a labour of love.

On his removal to his late residence, Parnham House (soon after which his health began visibly to decline) he ceased to possess an observatory, and was often heard to express his regret that his removal had compelled him to abandon it, notwithstanding all the pains and labour he had bestowed on its construction, and how sadly he missed its convenience and enjoyments. Yet he contrived occasionally to use his telescope and sidereal chronometer as an agreeable recreation, having the pillar for the equatorial erected on the lawn in his garden (the "Cooke" being now substituted for the "Dallmeyer," its greater portability being more suitable for the purpose) and providing the means of placing it in position. Nothing in these days afforded him greater delight than to be visited by an astronomical friend who would assist him in setting up his instruments in fine weather, and pass some hours with him in the observation of celestial objects, appreciating the performance of his small but beautiful telescope, and admiring the success of his arrangements which enabled him with such readiness to pick up the stars and planets in the sunshine.

For some years longer, however, he continued to edit and manage the *Astronomical Register*, taking the greatest interest in its well-being, and at times, unfortunately, seriously suffering the consequence of over anxiety, but his health and strength becoming wholly unequal to the task, he was compelled, but not without much reluctance, to relinquish it.

We think it may not be without interest to mention that our departed friend had from boyhood an extreme fondness for the sea, and all matters nautical, and we have the satisfaction to know that during the last five or six years he was permitted fully to indulge his propensity by residing during the summer and early autumn months in his yacht, the "North Star." On board this commodious vessel he enjoyed not only the pleasurable excitement of her management, and frequent change of scene, but he had also the important advantage of pure and bracing breezes, whereby in all probability his life was to some extent prolonged. Even to this he became gradually unequal, constantly increasing debility was to be succeeded by utter helplessness, which at last terminated in his demise in his 56th year.

Among all who had the happiness of knowing Sandford Gorton, and especially those who had the privilege of intimacy with him, there can be, we think, but one opinion of his character. He was at once a most amiable man, an intelligent and agreeable

companion, and a kind and affectionate friend, of an eminently social disposition, and enjoying much cheerfulness when comparatively in health, and many kind memories of him will survive and be cherished by a large number of our subscribers with whom he was personally acquainted, or was in the habit of corresponding. And for ourselves, we shall receive, we feel sure, from *all* our subscribers the heartiest sympathy in our deep sorrow, that our dear old friend, the originator of our pleasant serial, has at length passed away. R. I. P.

ROYAL ASTRONOMICAL SOCIETY.

Session 1878—79.

Annual General Meeting, February 14th, 1879.

Lord Lindsay, M.P., F.R.S., &c., *President*, in the Chair.

Secretaries—Mr. Glaisher and Mr. Ranyard.

The minutes of last year's Annual General Meeting were read and confirmed.

John Marshall, Esq., of Albion Place, Leeds, and
R. Palmer Thomas, Esq., of 13, North Villas, Camden Square,

were duly elected Fellows of the Society.

The Astronomer-Royal said: I take this opportunity, my Lord, to offer for the acceptance of the Society a photograph of a picture of Miss Caroline Herschel, presented by Lady Herschel. I believe it will be found to be not only a very good photograph but a very excellent portrait of this distinguished lady. (Applause.)

Lord Lindsay: I hope the portrait will be hung in the Council room beside our other Lady Associate, Mrs. Somerville. I feel sure I shall only be expressing the wish of the meeting when I request the Astronomer-Royal to return Lady Herschel the special thanks of the Society for her valued present.

After a discussion (which the reporters were requested not to take down) with respect to the rights and duties of members of the Society in balloting for names proposed for the Fellowship of the Society,

The President said: As it is possible that some gentlemen may have come here for the special business, of which notice has been given, and may wish to go away early, I think that it will be well to take the special business without delay. I will therefore shortly describe what is proposed by the Council.

In the year 1836, Dr. John Lee, then a Fellow and Treasurer

of the Society, executed a deed of gift by which he conveyed to the Society the Advowson of Hartwell, and in 1844, by another deed of gift, he conveyed the Advowson of Stone, to the Society.

About the same time, for family reasons, his estates were resettled by private Act of Parliament, by which the Manors of Hartwell and Stone were entailed, leaving Dr. Lee with only a life interest therein. The living of Stone fell vacant in the lifetime of Dr. Lee, and the Society presented Dr. Booth, who held the living until last April, when he died. The Council soon after received formal notice that the present Lord of the Manor of Hartwell, Mr. Edward Lee, intended to dispute the Society's title to both livings, on the ground that they were (in legal language) appendant to the Manors, and consequently included in the entail.

The Council, nevertheless, presented the Rev. James Challis, M.A. of Trinity College, Cambridge, who, besides being the son of Professor Challis, a distinguished Fellow of the Society, had many other recommendations. Mr. Lee took steps to dispute the presentation, and the Council employed as their solicitor Mr. Merriman, of Austin Friars, who has unusual opportunities of being acquainted with such matters. The result of Mr. Merriman's investigation was that he found that the Advowson of Stone had long been severed from the Manor, and that the Society's title was good; but in the case of Hartwell the matter was at least very doubtful. The litigation to establish such a claim, depending on historical inquiries, would be very costly, and even if the Society succeeded, it would have to bear a great part of the costs, which could not, according to the rules laid down by the Courts, be recovered from the other side. The cost of such a trial would obviously be of less consequence to a landowner wishing to retain a family living than a scientific society, and the Council felt sure that the Fellows would not approve of their risking the funds of the Society on such a litigation.

It was found that Mr. Lee did not want to present any friend of his own to the vacant living, and was willing to give £700 for the Advowson of Stone, subject to the Society's right of presentation to the present vacancy—a release of the Society's claim to Hartwell being also given at the same time.

Under these circumstances the Council considered the sum of £700 to be a fair price, and they entered into a provisional agreement with Mr. Lee, which it was resolved to recommend the Fellows to confirm.

The President then invited discussion upon the question.

Mr. Freeman said: No doubt this proposition will be seconded shortly.

The President: It does not require seconding, as it proceeds from the Council.

Mr. Freeman: I rise first of all to ask for a little information, which I think the Secretaries will probably be able to give at once. The first question is as to the date of the private Act of Parliament.

Mr. Glaisher: 1832, I think.

Mr. Freeman: It is quite sufficient if I know it is previous to 1844.

Mr. Ranyard: It is certainly previous to the year 1836.

Mr. Freeman: That is enough. The next question is as to annual value of the living of Hartwell, and the annual value of the living of Stone.

Sir Edmund Beckett: Mr. Merriman investigated that question, and he believed the real value of the living of Stone would not be above £350 a year, so that we get two years purchase for it, and to Hartwell we have no title.

Mr. Freeman: After that information all I would observe is that we seem to be selling the livings at a very moderate price. But, still, I quite agree with the view that it is undesirable that this Society should continue to hold the gift of the livings. No doubt we owe a great deal to the memory of Dr. Lee (hear, hear), and under the circumstances we ought not to make a hard bargain. I am happy to find that the Council have made the agreement proposed.

Mr. Heaven: I have much pleasure in supporting the resolution which comes from the Chairman. I know, perhaps, as much about the circumstances of the case as most gentlemen here, for I have been Curate of Stone for many years, and I think that the Society have done well to get out of the living of Stone at the value put upon it. The house, I know, is in a dilapidated condition, and in a short time will have to be rebuilt by the patrons. The Church also has been restored perhaps a little within the last twenty or thirty years, but the roof is in a dilapidated condition. I think, therefore, the Society will do well to accept the offer.

The President then put the resolution, which was carried unanimously.

Mr. David Gill: I beg to propose that the President's address be now taken before the formal report of the Council is read.

Mr. Neison having seconded the motion.

Lord Lindsay then proceeded to deliver the *President's* address. He said: Your Council has this year awarded the Gold Medal of the Society to Professor Asaph Hall — for his discovery and observations of the satellites of *Mars* and his determinations of

their orbits. It has been usual for the President in delivering his address to state the reasons which have influenced the Council in their award, and to give a brief history of the discovery or research which they have held worthy of such high esteem. In following the example of my predecessors in office, I would crave your indulgence if I slightly deviate from custom and allude to some of the work which had rendered the name of our Medallist familiar before he announced his great discovery to the world.

From 1858 to the present time almost every volume of the *Astronomische Nachrichten* contains notices of his zealous observation of minor planets and comets. Not content with mere observation he has in many cases given ephemerides, and has taken into account the perturbations due to *Jupiter* and *Saturn*.

Born at Goschen on October 15, 1829, Mr. Hall received his early education at the hands of his father at the village school. In 1842 he was left an orphan, and from comparative affluence he was reduced to work for his living. In 1856 he went to Cambridge, Mass., and entered the observatory under W. C. Bond; there he remained till 1862, when he was appointed one of the aids in the Naval Observatory, Washington. In 1863 he published a Memoir on the Solar Parallax deduced from observations of *Mars* with equatorial instruments, made at Upsala, Santiago, and Washington; combining all the results he found

$$\pi = 8''.8415.$$

After describing at some length the other labours of Professor Hall previous to his discovery of the satellites of Mars, Lord Lindsay proceeded to give an account of the various unsuccessful searches for satellites of the planet which had been made previously to the opposition of 1877.

During the favourable opposition of 1830 Mädler searched for a satellite of Mars with a refracting telescope $3\frac{3}{4}$ inches in aperture, the same instrument which he afterwards employed for his lunar work, but his search was in vain, and he came to the conclusion that if such a satellite existed, and if it possessed the same reflecting power as its primary, that it could not exceed the diameter of twenty-three miles, since a larger one could not escape discovery under favourable circumstances.

Though at the time the conclusions thus drawn were considered hardly justifiable, still, as time wore on, and larger instruments were employed, Mädler's estimate obtained better consideration.

Professor d'Arrest made a search for a satellite in the year 1864, but he was again unsuccessful.

In a paper in the *Astronomische Nachrichten*, vol. 64, p. 74, d'Arrest, assuming the distance of Mars from the earth to be

0·52, and with an assumed mass for the planet, computed the apparent elongation of a satellite which would revolve around the planet in a given time. Thus he showed that an elongation of 70′ would give the satellite a period greater than the period of Mars round the sun, or, in other words, greater than 687 days. From this the inference was drawn that it is useless to search for a satellite at a greater distance than 70′.

The previous failures of distinguished observers did not, however, discourage Professor Hall from instituting a fresh search. Commencing with faint objects at a considerable distance from the planet, it was soon found that they were nothing but fixed stars, and on August 10th the search was commenced in the region close to the planet, and within the glare of light which surrounded it, keeping the disc of Mars just outside the field of view, sweeps were made all around, but, the definition being bad, nothing was found that night. The next night, August the 11th, the observations were resumed, the same method being adopted of sweeping. At 14h. 30m. Professor Hall discovered the outer satellite, but he had hardly time to complete the observation of its position when a fog springing up stopped his work. Until the 16th bad weather hindered further observations, but on that evening the satellite was again found on the north following side of the planet, and the observations of this night demonstrated clearly that it was moving with Mars, and that, if a satellite, it was near one of its elongations.

On the next evening, August 17th, while waiting for and watching the outer satellite, Professor Hall discovered the inner one, and obtained measures of it when at a distance of about 31″ from the centre of the planet. The last doubts as to the character of the faint objects thus found having been dispelled by the observations of the 17th and 18th August, the discovery was officially announced by Admiral Rogers. The appearances of the inner satellite were most perplexing. Professor Hall says, "For several days the inner moon was a puzzle; it would appear on different sides of the planet the same night, and at first I thought that there were two or three inner moons, since it seemed to me at that time very improbable that a satellite should revolve round its primary in less time than that in which the primary rotates. To set this point at rest Professor Hall watched the satellite throughout the nights of August 20 and 21, and was satisfied that there was but one inner moon, which performed its revolution in less than one-third of the time of the rotation of Mars. A case, as he observes, unique in the solar system.

Lord Lindsay then passed to a discussion of the method adopted by Professor Hall for determining the orbits from his

observations. The eccentricity of Phobos is about 1-30th, with a probable error of about 1-600th: but the eccentricity of Deimos is so small that we may consider the circular elements of this satellite as practically sufficient for the observations.

We now come to what may be considered the most important outcome of Professor Hall's discovery, namely, the determination of the mass of Mars. The result he obtained from Deimos gives—

$$M = \frac{1}{3095313 \mp 3485}$$

and from Phobos—

$$M = \frac{1}{3078456 \mp 10104}$$

Seeing that these two determinations fall so nearly within the limit of their respective probable errors, Professor Hall took the mean by weight as the final result for his observations, thus giving—

$$M = \frac{1}{3093500 \mp 3295}$$

On concluding his address, Lord Lindsay, turning to Mr. Ranyard, said, "May I request you, acting as the Foreign Secretary of the Society, to place this medal in the hands of the Minister of the United States, to be transmitted to Professor Asaph Hall, as the highest mark of esteem in the gift of the Royal Astronomical Society. Assure him at the same time of the deep interest we in England have ever felt in watching the progress of our beloved science in the hands of our cousins in the far west."

Portions of the annual report were then read, and the meeting proceeded to the election of officers and Council for the coming year. The following gentlemen were declared to be elected:

President.

Lord Lindsay, M.P., F.R.S.

Vice-Presidents.

J. C. Adams, Esq., M.A., LL.D., F.R.S., Lowndean Professor of Astronomy, Cambridge.
Sir G. B. Airy, K.C.B., M.A., LL.D., D.C.L., F.R.S., Astronomer-Royal.
William Huggins, Esq., D.C.L., LL.D., F.R.S.
William Lassell, Esq., LL.D., F.R.S.

Treasurer.

Francis Barrow, Esq., M.A.

Secretaries.
J. W. L. Glaisher, Esq., M.A., F.R.S.
A. Cowper Ranyard, Esq., M.A.

Foreign Secretary.
J. R. Hind, Esq., F.R.S., Superintendent of the *Nautical Almanac.*

Council.
Sir Edmund Beckett, Bart., M.A., LL.D., Q.C.
Arthur Cayley, Esq., M.A., LL.D., F.R.S.,
Sadlerian Professor of Pure Mathematics, Cambridge.
A. A. Common, Esq.
Edwin Dunkin, Esq., F.R.S.
David Gill, Esq.
E. B. Knobel, Esq.
George Knott, Esq., LL.B.
Albert Marth, Esq.
Edmund Neison, Esq.
Captain W. Noble.
Herbert Sadler, Esq.
Captain G. L. Tupman, R.M.A.

REVIEWS.

The Moon. Her motions, aspect, scenery, and physical condition. By Richard A. Proctor. With two lunar photographs by Rutherford, and many illustrations.. Second Edition. London: Longmans, Green and Co. 1878. pp. x and 314. Price 10s. 6d.

In the preface to this edition the author says that, owing to the difficulty of portions of the original work, he has removed the matter relating to the details of the lunar theory (leaving the general account of the moon's motions), and the more difficult parts of chapter III. These will be reprinted in another volume on the "Geometry of the Lunar Theory, Tides, Precession, &c.," for use in colleges and by the higher classes in schools. The illustrations, which in the former edition were arranged in plates of diagrams, lithographed, appear here as woodcuts. The last chapter, on the moon's physical condition, has been considerably enlarged.

The first edition of this book was reviewed in the *Astronomical Register* for October, 1873. As generally in Mr. Proctor's works we find subjects seldom, if at all, treated elsewhere, and the student would do ill to dispense with this work if he can help it. Chapter I. is on *the moon's distance, size, and mass.* "Roughly, we may take the moon's diameter as two-sevenths of the earth's, her surface as two twenty-sevenths, her volume as two ninety-ninths." Her surface is about the same as the areas of Europe and Africa together, and almost exactly equal to the areas of North and South America, islands in both cases excluded. The earth's mass (quantity of matter) exceeds the moon's 81½ times. "If the earth's mean density be held to be 5·7 times that of water, the moon's mean density is rather less than 3⅔ times the density of water." The moon's mean distance is taken in this work as 238,818 miles. Chapter II.

is on *the moon's motions*. On p. 65 an error is pointed out in Herschel's Outlines, &c. This had also been noticed by Lardner, pp. 629—30 of his Astronomy (original edition); and it appears to us to have arisen probably from a misprint. Chapter III. is on *the moon's changes of aspect, rotation, libration*, &c. The rotation of our satellite, about which some, for aught we know, may yet mystify themselves and others, is very well explained, and the rather intricate subject of libration is fully illustrated. "If we represent the whole sphere by 1, the area of the part absolutely invisible will be represented by 0·4198." . . . If, however, we take into account the effects of the diurnal libration . . . the portion of the moon, which is never seen under any circumstances, bears to the area of the whole moon almost exactly the proportion . . . which 37 bears to 90, that is, it is equal to 0·4111 of the whole area. Chapter IV., *study of the moon's surface*, gives an account of Selenography from Galileo to Schmidt and Webb. The map of the latter, with accompanying tables and indexes, is inserted at the end of the volume. (On p. 152, for 1¼ feet we should read 11 feet). On p. 160 we learn that, by two distinct methods, Zöllner found the light of the full moon to be one 618,000th part and one 619,000th part of the sun's light. Chapter V. treats of *lunar celestial phenomena*. Chapter VI. of *the condition of the moon's surface*. (On page 264, "dusty" should be "dusky"; p. 284, line 2, "so" should be "to"; and p. 297, line 9, b'c' seems a misprint for a'b').

We transcribe the concluding part of this chapter, and of the book, relative to the probable changes still taking place in the moon's surface. It is an interesting and valuable summary. "When observations thus carefully conducted are made, and when the effects of libration, as well as of the sun's altitude above the lunar regions studied are carefully taken into account, we should be better able than we are at present to determine whether the moon's surface is still undergoing changes of configuration. I cannot but think that such an inquiry would be made under more promising circumstances than those imagine who consider that the moon's surface has reached its ultimate condition, and that therefore the search for signs of change is a hopeless one. So far am I from considering it unlikely that the moon's surface is still undergoing change, that, on the contrary, it appears to me certain that the face of the moon must be undergoing changes of a somewhat remarkable nature, though not producing any results which are readily discerned by our imperfect telescopic means.

"It is not difficult to show reasons for believing that the face of the moon must be changing more rapidly than that of our earth. On the earth, indeed, we have active subterranean forces which may, perhaps, be wanting on the moon. On the earth, again, we have a sea acting constantly upon the shore—here removing great masses, there causing the *débris* to beat down other parts of the coast, and by the mere effect of accumulated land-spoils acquiring power for fresh inroads. We have, moreover, mud and rain, river action, and glacier action, and, lastly, the work of living creatures by land and by sea, while most of these causes of changes may be regarded as probably, and some as certainly, wanting in the case of our satellite. Nevertheless, there are processes at work out yonder which must be as active as any of those which affect our earth. In each lunation, the moon's surface undergoes changes of temperature which should suffice to disintegrate large portions of her surface, and with time to crumble her loftiest mountains into shapeless heaps. In the long lunar night of fourteen days, a cold far exceeding the intensest ever produced in terrestrial experiments must exist over the whole of the unilluminated hemisphere; and under the influence of this

cold all the substances composing the moon's crust must shrink to their least dimensions—not all equally (in this we find a circumstance increasing the energy of the disintegrating forces), but each according to the quality which our physicists denominate the co-efficient of expansion. Then comes on the long lunar day, at first dissipating the intense cold, then gradually raising the substance of the lunar crust to a higher and higher degree of heat, until (if the inferences of our most skilful physicists, and the evidence obtained from our most powerful means of experiment can be trusted), the surface of the moon burns (we may almost say) with a heat of some 500° F. Under this tremendous heat all the substances which had shrunk to their least dimensions must expand according to their various degrees; not greatly, indeed, so far as any small quantity of matter is concerned, but to an important amount when large areas of the moon's surface are considered.

"Remembering the effects which take place on our earth, in the mere change from the frost of winter to the moderate warmth of early spring, it is difficult to conceive that such remarkable contraction and expansion can take place in a surface presumably less coherent than the relatively moist and plastic substances comprising the terrestrial crust, without gradually effecting the demolition of the steeper lunar elevations. When we consider, further, that these processes are repeated, not year by year, but month by month, and that all the circumstances attending them are calculated to render them most effective because so slow, steadfast, and uniform in their progression, it certainly does not seem wonderful that our telescopists should from time to time recognize signs of change in the moon's face. So far from rejecting these as incredible, we should consider the wonder rather to be that they are not more commonly seen, and more striking in their nature. Assuredly there is nothing which should lead our telescopists to turn from the study of the moon as though it were hopeless to seek for signs of change on a surface so desolate. Rather they should increase the care with which they pursue their observations, holding confidently the assurance that there are signs of change to be detected, and that in all probability the recognition of such change may throw an instructive light on the moon's present condition, past history, and probable future."

These views accord generally with those of Mr. Neison in his work on the moon, and we think there can be no doubt of their soundness. Two of Rutherford's beautiful photographs and other excellent illustrations adorn this volume, which we rejoice to see in a new edition for its own sake, and also because of the announcement in it of another work by its author, which will no doubt be as welcome to the more advanced student as the present volume is to the general reader. On this account our gratitude, sincere though it be, has just a little of a "lively sense of favours to come."

Etudes et Lectures sur L'Astronomie. Par Camille Flammarion, Tome huitième, accompagné de 32 figures astronomiques. Paris: Gauthier-Villars, 1877. pp. 299. [London: David Nutt. 2s. 6d.]

This volume has been delayed a long time in expectation of the results of the transit of Venus. It contains an account of all the expeditions for its observation, as well as a general history of the subject. Ch. IX. describes experiments and researches, optical and photographical, by MM. André and Angot, proving the importance of determining in every case the *constant of instrumental diffraction*, to which is attributed, among other things, the phenomenon of the "black drop." This subject seems

to deserve great attention. M. von de Sande Backhuysen, director of the observatory of Leyden, had before independently arrived at similar conclusions. Ch. X. is about the passages of Venus *behind* the sun. And lastly, we have a list of all the observatories in the world, 182 in number; any omissions or corrections in which, addressed to M. Flammarion will receive attention. We have been much interested in this volume. Vol. IX. is in the press, and will soon appear. It will treat of recent discoveries in solar, planetary, and sidereal astronomy.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

To all communications must be annexed the name and address of the sender, as a guarantee of good faith.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

OCCULTATION OF η TAURI.

Sir,—Occultations of stars, perceptible without telescopic aid, are sufficiently rare to deserve a few words of remark. Such, however, would probably have been the case with that of η Tauri on the night of January 31, a disappearance at Greenwich, but in some parts of the kingdom so affected by parallax as to render it merely a very close appulse. Here the sky was overcast, as it had been many days and nights previously. This occultation may remind the historical student of astronomy of the first recorded one of the Pleiades, happening, in some respects, under similar circumstances. Old Street in his "Astronomia Carolina," gives us the following account of it, followed by calculations from the imperfect tables of his day, in verification of the phenomenon: "In the year B.C. 283, January 29th, in the end of the third hour of the night, Timocharis diligently observed the southern middle of the moon falling upon the third and middle stars of the Pleiades. Ptolemy, lib. 7."

Upton Helions Rectory: S. J. JOHNSON.
Feb. 1, 1879.

LUNAR OBJECTS.

Sir,—On p. 54 Mr. Birt mentions my letter on the subject of the Proclus light streaks in the *English Mechanic* for Jan. 17. It may perhaps be well to give the positions of the nine principal streaks which I have observed. The numbers begin from the north and go round by E. to N. again. Any smaller streaks between any of the two numbered streaks should be numbered 1, 2, 3, &c.,

in the same direction. The streaks here given were observed on the evening of January 8, 1879.

I. Between a line drawn from the E. border of Proclus, through D to Macrobius, and one from the N. border of Proclus towards a peak S. of Le Monnier, the whole district is filled with fine streaks divergent from Proclus N.E. wall. The first of these is I., and the others will be registered 1, 2, &c.

II. From the N. border of Proclus, on a line towards a peak a little S. of Le Monnier, till about midway between Proclus and Macrobius "*a*." It then becomes more diffused, and passes between "*a*" and B, on a line towards Posidonius B. After passing between "*a*" and B it soon loses itself.

III. From the S.E. border of Proclus, on a line towards Taruntius A, but loses itself in the highlands N. of that crater.

IV. From S. border of Proclus, close N. of Picard "*d*." It loses itself S. of Picard, and is very faint.

V. From S. border of Proclus to Picard's E. wall, where it stops.

VI. From S. border of Proclus, through Picard E., and continued to between Picard and Peirce. Very faint.

VII. From just N. of Proclus's N. border, parallel to VI., and brighter, the two being about equidistant from the centre of a line from Picard to Peirce, and continued nearly to the apparent middle of the Mare.

VIII. From a little S. of the S. border of Proclus to Peirce A, a little before reaching which a broader and more diffused ray leaves it, which curves round the S. border of A, and continues gradually divergent to the border of the Mare S.E. of Eimmart.

IX. From the N. border of Proclus to the S. border of Cleomedes F.

On the following night VI. seemed rather brighter, and VII. rather shorter than on Jan. 8, and VIII. was easily visible till it nearly reached the N. border of the Mare which was on the terminator. Mr. Birt's N. streak is evidently VIII. His middle one seems to correspond with my VI., though I cannot understand his overlooking the brighter VII. His S. one is evidently my V.

Southampton: Feb. 14. FRANK C. DENNETT.

EXPECTED TRANSIT OF VULCAN, March 18, 1878.

Sir,—The last number (2239) of the *Astronomische Nachrichten* contains an interesting paper on the Vulcan controversy, by M. Oppolzer, of Vienna. Time fails me at this moment to translate the whole of it for your columns, but the following paragraph is too important to be delayed:

"It follows from the elements which I have given that there will be a transit on March 18 of this year, so near the central line that the uncertainty of the elements cannot have any essential influence. The approximate circumstances of this transit involve the following figures:

1879.		Berlin M.T. h.	Position Angle. °
March 18	Ingress ...	18 8	... 74
	Egress ...	23 15	... 254."

I would counsel all persons of suitable instruments and good clocks not to let this occasion slip for a further effort to clear up what is, to say the least of it, a very curious astronomical enigma, the existence or non-existence of Vulcan. For my own part I never have changed my opinion that the reality of Lescarbault's planet will one day be ascertained beyond all doubt.

Northfield Observatory, Your obedient servant,
Eastbourne: Feb. 8, 1879. G. F. CHAMBERS.

NAMES OF MARKINGS ON MARS.

Dear Sir,—The letters on this subject may be divided into two classes: those influenced by sentiment, and those prompted by utility. Sentiment would be gratified by the removal of the names, considering them objectionable. Utility prefers to retain these names, having proved them to be valuable.

Mr. Proctor, for his own convenience, forms a map of Mars, giving names to identify the various markings. Observers accept this map, finding it suit their purpose also, and thus it finds its way, together with its belongings, into various letters, pamphlets, and books, and for twelve years it is the only effectual guide to the planet. At length objectors arise, who say this system is the worst possible, and recommend other systems not to be compared with it in point of practical utility. For proof let us transfer the argument to the surface of the moon. There, as map after map has been formed, names have been found the most effectual way of identifying the prominent craters. The sounds Tycho, Copernicus, Plato, bring at once before the mind each formation, together with its surroundings, and that in a manner more graphic and complete than could possibly be effected by any combination of letters or figures. Why, then, is a system that has proved so eminently useful on the lunar surface to be considered objectionable when applied to the markings of Mars?

In considering this question, the labours of those who have devoted their time and attention to the subject should surely have some weight. Dr. Terby alone has some hundred pages of

letterpress in one publication, all based on the nomenclature of Mr. Proctor's map. Is all this earnest effort to be confused, or reduced in value, simply because there may be some objection to the use of names?

A most decisive reason should be given for change, and if a sentimental objection is all that can be advanced it should not be allowed to interfere with the labour of years.

I am, dear Sir, yours very respectfully,
NATHL. E. GREEN.

Dear Sir,—I have been favoured with a letter from Professor Trouvelot. His remarks are so much to the point that I cannot do wrong in forwarding an extract for the *Register*. The Professor writes under date Cambridge, U.S., Feb. 4: "The multiplication of maps of Mars, with different systems of nomenclature, would be very injurious to astronomy, and throw much confusion into its study. The nomenclature adapted by Mr. Proctor in his chart of Mars is more extensively used and better known, I think, than any other, and I see no very serious objection to it."

Here, then, we have another worker who considers it unadvisable to alter the present system.

Yours very respectfully,
NATHL. E. GREEN.

NOMENCLATURE OF MARKINGS ON MARS.

Dear Sir,—However desirable it would be to alter the nomenclature of the Martial markings, I fear that it is now too late to wholly effect this object, and I fancy that the best course now would be to retain the universally known elder and conspicuous names, and totally to eschew the recent and less distinguished appellations. I would then express any newly-traced marking on those parts with a numerical or a Greek letter.

It may be a *present* compliment, but must be simply ridiculous to *future* astronomers, to call each newly-discovered marking by the names of individuals of no lasting scientific eminence. Surely we can do better than crowd our map with such phrases as Brown's Bay, Jones' Strait, Robinson's Channel, &c., &c. While there is yet opportunity we ought to vigorously oppose any fresh innovations in this way, and I would strongly recommend this matter to the consideration of Mr. Green for practical application in his new map of Mars.

Ballybrood House, E. B. FENNESSY.
Pallasgreen, Co. Limerick: 11.1.79.

WORK ON THE MOON.

Sir,—Your correspondent T. P. G. should obtain Mr. Neison's book "The Moon," published by Longmans. It is undoubtedly the most complete and exhaustive work upon lunar detail in the English language. It is illustrated primarily by a map upon the scale of two feet to the moon's diameter, and this is divided into twenty-two sections, for convenience of reference. Besides this is a key map, and there are moreover several drawings and maps of individual craters. Avowedly based upon "Der Mond," of Beer and Mädler, it contains several corrections and numerous additions in the shape of hills, &c., not shown upon their large chart at all. As a means of identifying objects upon the surface of our satellite, and of learning in compendious form what is at present known concerning their physical structure and configurations, Mr. Neison's book is indispensable in every amateur observatory. I speak quite disinterestedly, because I differ *toto cœlo* from its author about the existence of a lunar atmosphere.

Forest Lodge, Maresfield, Uckfield: January 9, 1879.

I am, Sir, obediently yours,
WILLIAM NOBLE.

EXPLANATION OF NAMES on MAP of the MOON.

Sir,—Your own catalogue, together with the supplementary lists of Messrs. McCance and Prince, Capt. Noble and Lord Lindsay, furnish for the first time a nearly complete list of the different persons whose names have been given to different formations. Will you permit me to make a few observations on some of the names with the view of eliciting further information?

Ansgarius. This is one of Mädler's names, so I do not think it has been rightfully identified with the celebrated Bishop of Bremen, for I do not remember another of Mädler's names taken from a similar source.

Blanchinus. This is one of Schröter's names, and cannot well be intended for the well-known Italian astronomer Bianchini. Mr. Prince's identification is not satisfactory, for it does not come from a similar class to the rest of Schröter's names.

Bettinus. It would appear that Lord Lindsay must have overlooked the fact that this is one of Riccioli's names, and thus could not have been named after the Jesuit of this name, who was not born for nearly a century after Riccioli's death. Mr. Prince's identification seems probable.

Gérard. This is another of Mädler's names, and I do not think any of the three identifications is very satisfactory. It was not from such a class that Mädler drew his names.

Gruemberger. Both Lord Lindsay and Mr. Prince suggest that this is intended for Grumberger, a Jesuit professor of mathematics at Rome in the sixteenth century. It is strange that Schröter should have missed the name, and is not a likely source. I had always been under the impression that this formation was named after a colleague of Mayer's.

Halin. Another of Mädler's names. Lord Lindsay suggests Count Frederick von Halin. I would rather suggest Schröter's correspondent General von Halin, a well-known lunar observer.

Housteen. Through an error this name is ascribed to Riccioli in my work on the moon. It is really one of Mädler's.

Hippalus. Mr. Prince suggests that this may be intended for Harpalus, but this cannot be so, for another formation named Harpalus exists.

Moretus. Lord Lindsay's identification probably correct.

This leaves only three names unidentified, Mösting, Tarantius, and Zapas. The first is one of Mädler's names, and it has been suggested by Schmidt that it ought to be Möethis.

January 8, 1879. E. NEISON.

ρ *OPHIUCHI.*

Sir,—Mr. Gore in his pleasant little work, "Southern Stellar Objects," after quoting Sir John Herschel's remark about this object, "No other star but its two companions, on an intensely black ground," writes as follows, "With 3·9-inch I observed a faint comes about 13m. to the south, and more than double as far from the previous star as either of the 8m. companions, June, 1875. If Herschel did not see this small star it must be variable, as it is now plain with 3·9-inches. I glimpsed it with the 3-in. July, 1875. In May, 1876, I find it nearly steady with 3-inches." On another occasion Herschel notes of this double star, "In great black space, has two stars 8m. near." I think it more probable, however, that Herschel's failure to detect the star of which Mr. Gore speaks, arose rather from his using an eyepiece giving a small field of view than from any actual variability of the star in question. Smyth in the "Cycle" speaks of ρ in the following terms: "A 5, pale, topaz yellow; B 7½, blue, and they directly point upon 72 P, Hora. xvi., about 2½ *n. f.* There are two others in the field, the whole forming a pretty group," and in the MSS. of the "Cycle," he says, "It [72 P] is of the sixth magnitude, and there

is another of the same *s. p.*, besides several small stars." Smyth's observations were made about three years before Herschel's. Chacornac in his "Atlas Ecliptique," map 49, shows a small star of 11½ Arg. (13m. Smyth) about 7′ distance from ρ on an angle of $\pm 220°$. This is probably the star Mr. Gore found. Besides the two 8m. (Herschel) companions, and the little star referred to above, Chacornac shows six others within a radius of 15′ round ρ, one of the 12th magnitude (Arg.) the other of the 13th or below. His charts are supposed to include all stars visible in a 10½-inch refractor. Herschel in 1835 gave for the position angle of D 287°, just eleven years later 233°·8, which appeared to me to be about the correct value. When I examined this object in June, 1875, I did not notice Mr. Gore's little star, which would have been outside the field of the eyepiece I used.

The magnitudes of the components of ρ would seem to undergo considerable fluctuations. Herschel in May, 1781 marked "they are unequal"; in April, 1782, he calls them "pretty unequal," and in June, 1804, "a little unequal." H. and S. in the summer of 1832 give one magnitude difference between the components. Smyth in 1832·4 calls them 5 and 7½ respectively. Two years later H., at the Cape, made them exactly equal with the 7-ft. equatorial, and again in 1835 and 1837, with the 20-ft. equatorial, Jacob at the epoch 1846·2 calls them "exactly equal magnitudes." Se. in 1856 and 1857 gives one magnitude difference, and Main in 1861-4 calls them 4m. 4·3m. Sm. has of course assumed the magnitude of A from the Palermo Catalogue. H. in 1835 rates them 7½ magnitudes, in 1837 7 mags., and in the catalogue of Herschel and South, they even appear as low as 8 and 9 magnitudes, but South's scale is a very arbitrary one. These stars should be carefully watched.

I am, Sir, yours, &c.,
HERBERT SADLER.

P III 213 *TAURI.*

Sir,—The more distant component of this triple object is suspected variable by Webb. Smyth seems to have rated it as 12 mag., South is said to have missed it altogether in 1823, Darby in the *Astronomical Observer* calls it a most difficult object, of late years, therefore, it must have been brighter. On observing to-night there was no difficulty in catching it with 2¼ inches, so that it cannot be lower in magnitude than 9 or 9½ at most, and I find on March 24, 1875, I had a similar impression. The bluish colour is discernible even in a small instrument.

Upton Helions Rectory, S. J. JOHNSON.
Crediton: Jan. 11.

ASTRONOMICAL OCCURRENCES FOR MARCH, 1879.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage
		h. m.			h. m. s.	h. m.
Sat	1		Saturn's Ring: Major axis=36".06 Minor axis= 3".12			Procyon — 8 55·9
Sun	2	4 52	Occultation of 139 Tauri (5½)			
		6 4	Reappearance of ditto			8 51·9
		21	Conjunction of Saturn and Venus 1° 11′ N.			
Mon	3	9 19	Occultation of ω Geminorum (6)			
		10 16	Reappearance of ditto			8 48·0
		20	Superior conjunction of Venus and Sun			
Tues	4					8 44·1
Wed	5	11 58	Occultation of o^2 Cancri (6)			8 40·1
		12 25	Reappearance of ditto			
Thur	6					8 36·2
Fri	7					8 32·3
Sat	8	1 9	○ Full Moon			8 28·3
Sun	9	8 14	Occultation of B.A.C. 4201 (6)			
		9 11	Reappearance of ditto			8 24·4
		11 12	Occultation of *q* Virginis (6)			
		12 17	Reappearance of ditto			
Mon	10					8 20·5
Tues	11					8 16·5
Wed	12					8 12·6
Thur	13					8 8·7
Fri	14	15 40	☾ Moon's Last Quarter			8 4·7

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sat	15	0	Conjunction of Saturn and Mercury 2° 7′ N. Illuminated portion of disc of Venus=0·916 Illuminated portion of disc of Mars=0·911			Procyon — 8 0·8
Sun	16					7 56·9
Mon	17	8	Conjunction of Moon and Mars 0° 38′ S.			7 52·9
Tues	18			1st Ec. D.	17 35 46	7 49·0
Wed	19	18	Conjunction of Moon and Jupiter 3° 19′ S.	1st Tr. E.	17 53	7 45·1
Thur	20	18	Conjunction of Mercury and ε Piscium 0° 9′ N.			7 41·2
Fri	21		Saturn's Ring : Major axis=35″·80 Minor axis= 3″·80	4th Ec. R.	17 31 4	7 37·2
Sat	22	9 4 22	● New Moon Conjunction of Moon and Saturn 7° 23′			7 33·2
Sun	23					7 29·4
Mon	24	2 23	Conjunction of Moon and Mercury 3° 37′ S. Conjunction of Moon and Venus 5° 37′ S.			7 25·4
Tues	25					7 21·5
Wed	26	6	Conjunction of Saturn and Sun	1st Tr. I.	17 34	7 17·5
Thur	27			1st Oc. R.	17 4	7 13·6
Fri	28					7 9·7
Sat	29					7 5·8
Sun	30	13 4 7 16 7 53	☽ Moon's First Quarter Occultation of B.A.C. 2154 (6½) Reappearance of ditto	2nd Tr. I.	16 51	7 1·8
Mon	31					6 57·9
APRIL Tues	1					6 53·9

THE PLANETS FOR MARCH.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury ...	1st	22 48 48	S. 9 33½	4″·8	0 6·2
	9th	23 37 48	S. 3 39½	5″·0	0 30·5
	17th	0 33 3	N. 3 46	5″·5	0 54·1
	25th	1 20 25	N.10 26½	6″·7	1 9·9
Venus ...	1st	0 5 40	S. 0 37	10″·6	1 29·8
	9th	0 41 40	N. 3 32	10″·8	1 34·2
	17th	1 17 47	N. 7 36½	11″·0	1 38·8
	25th	1 54 24	N.11 30	11″·3	1 43·8
Uranus ...	2nd	10 16 16	N.11 36	4″·2	11 34·7
	18th	10 13 47	N.11 50	4″·2	10 29·4

Mercury will be favourably situated for observation towards the end of the month, setting nearly two hours after sunset.

Venus sets about two hours after the sun at the beginning of the month, the interval slightly increasing.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN MARCH, 1879.

BY W. R. BIRT, F.R.A.S., P.S.S.

PLATO. On the interior of the ring of this walled plain two landslips have been suspected, one on the S.W. portion and one on the East. Previous to the year 1861, or rather between 1859 and 1861, the summit of the S.W. part of the ring rose to a rather considerable altitude, so that its lingering shadow fell on a ledge on the interior of the S.W. slope between the summit and the floor of Plato, when the floor had become fully illuminated. As the sun rose higher above the summit, the shadow was edged by a lucid fringe which could be seen as quite distinct from the floor. It was in the neighbourhood of this ledge, then called the "Hartwell Ledge," that the south-west landslip was suspected, and it is this part of the interior of the ring of Plato that is now recommended for observation, with a view to ascertain if any alteration has occurred in the ledge itself, or in its neighbourhood, since 1861.

The eastern portion of the ring of Plato is distinguished by a high rock, marked ζ by B. and M. which attains an altitude of 7418 feet above the floor. Immediately south of this rock, on the wall, is a comparatively shallow depression which, previous to April, 1866, was surrounded on all sides by a low wall. It was at the date just quoted that the Rev. T. W. Webb remarked that the western part of the wall was absent, and this he attributed to a landslip. We are not aware that any observations have been made of late on this object, but it is very desirable that all parts of the interior of the ring of Plato should be more carefully examined, more especially the two portions above specified.

It would also be well if the floor of Plato were examined with powerful telescopes, and careful drawings made of the spots and streaks for comparison with the drawings published in the reports of the Lunar Committee of the British Association in the year 1871 and 1872.

VARIABLE STARS, MARCH.

Approximate times of minima and maxima, according to Schönfeld and Winnecke.

1879.	Gr. h.	Star.		mag.	R.A. 1855. h.	m.	s.	Decl. 1855. °	′
March 2		T Serpentis.	max.	9·5	18	21	44	+ 6	12·5.
—	17·1	Algol.	min.	4	2	58	45	+ 40	23·6.
3	5·7	S Cancri.	min.	10	8	35	39	+ 19	33·2.
—	16·6	δ Libræ.	min.	6	14	53	14	— 7	56·4.
—		S Vulpeculæ.	min.	9·5	19	42	27	+ 26	55·7.
5	14·0	Algol.	min.						
7	15·9	U Coronæ.	min.	9	15	12	17	+ 32	10·8.
8	10·8	Algol.	min.						
10	16·2	δ Libræ.	min.	6					
11	7·6	Algol.	min.						
—		R Boötis.	max.	7	14	30	48	+ 27	22.1.
13		U Tauri.	max.	9	4	43	39	+ 17	17·4.
—	13·0	λ Tauri.	min.	4	3	52	39	+ 12	4·6.
14	14·5	U Coronæ.	min.	9	15	12	17	+ 32	10·8.
17	11·9	λ Tauri.	min.	4					
—	15·7	δ Libræ.	min.	6					
19		S Ursæ maj.	min.	11	12	37	35	+ 61	53·3.
20		T Canis min.	max.	9	7	25	56	+ 12	3·0.
—		T Delphini.	max.	8·5	20	38	38	+ 15	52·5.
21	10·7	λ Tauri.	min.	4					
—	12·3	U Coronæ.	min.	9	15	12	17	+ 32	10.8.
24	15·3	δ Libræ.	min.	6					
—		T Sagittarii.	max.	7·5	19	7	52	— 17	13·2.
25	9·6	λ Tauri.	min.	4					
—	15·7	Algol.	min.	4					
26		T Cancri.	min.	11	8	48	23	+ 20	24·1.
27		U Cancri.	max.	8·5	8	27	28	+ 19	23·5.
28	10·0	U Coronæ.	min.	9	15	12	17	+ 32	10·8.
—	12·5	Algol.	min.	4					
29	8·5	λ Tauri.	min.	4					
31	9·4	Algol.	min.	4					
—	14·8	δ Libræ.	min.	6					
—		S Vulpeculæ.	max.	9	19	42	27	+ 26	55·7.

SATELLITES OF URANUS.

Major and minor semi-axes a and b of the apparent ellipses described by the satellites, and position-angles p_0 of the major axes:

1879.	Ariel. a	Ariel. b	Umbriel. a	Umbriel. b	Titania. a	Titania. b	Oberon. a	Oberon. b	p_0
	″	″	″	″	″	″	″	″	°
Mar. 6	15·25	3·69	21·24	5·14	34·84	8·44	46·59	11·28	12·66
16	15·20	3·79	21·17	5·27	34·73	8·65	46·44	11·56	12·57
26	15·13	3·86	21·08	5·38	34·57	8·82	46·23	11·79	12·48

In these apparent orbits the satellites move in the direction of decreasing position-angles, from their greatest northern elongation N. (in position angle 12°·6) to inferior conjunction (pos. 282°·6), greatest southern elongation S. (pos. 192°·8), superior conjunction (pos. 102°·6), etc. The satellites will be at these points of their orbits about the following hours, G.M.T.:

Ariel.			Umbriel.			Titania.			Oberon.		
1879.	h.			h.			h.			h.	
Mar. 1	0	N.	Mar. 3	0	N.	Mar. 1	15	N.	Mar. 0	20	S.
2	6	S.	5	2	S.	3	19	inf.	4	4	sup.
3	13	N.	7	3	N.	5	23	S.	7	13	N.
4	19	S.	9	5	S.	8	3	sup.	10	22	inf.
6	1	N.	11	7	N.	10	8	N.	14	7	S.
7	7	S.	13	9	S.	12	12	inf.	17	16	sup.
8	14	N.	15	10	N.	14	16	S.	21	0	N.
9	20	S.	17	12	S.	16	20	sup.	24	9	inf.
11	2	N.	19	14	N.	19	1	N.	27	18	S.
12	8	S.	21	16	S.	21	5	inf.	31	3	sup.
13	15	N.	23	17	N.	23	9	S.	Ariel.		
14	21	S.	25	19	S.	25	13	sup.	23	17	N.
16	3	N.	27	21	N.	27	18	N.	24	23	S.
17	9	S.	29	23	S.	29	22	inf.	26	5	N.
18	16	N.	32	0	N.	32	2	S.	27	11	S.
19	22	S.							28	18	N.
21	4	N.							30	0	S.
22	10	S.							31	6	N.
									A. M.		

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec., 1878.
Fletcher, I.
Little, W.
Neison, E.
Slater, J.

To March, 1879.
Lewis, H. K.
Worthington, A. M.

To Sept., 1879.
Lettsom, W. G.

To Dec., 1879.
Backhouse, T. M.
Baxendell, J.
Hederstedt, H. B.
Johnson, R. C.
Loddiges, C.
Monkhoven, Dr. D. v.
Parnell, J.
Smith, Dr. R.

To July, 1880.
Bookwalter, F. M.

TO CORRESPONDENTS.

We cannot publish communications which are not authenticated by the name and address of the sender, as a guarantee of good faith.

When subscriptions sent by post are not acknowledged in the next number, the Editor will be much obliged if subscribers will *at once* inform him of the fact.

All Letters requiring an answer must enclose a penny stamp.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or *penny* postage stamps, but the Editor will not be liable for loss in transmission.

Post Office Orders for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage to all parts of Great Britain and Ireland) is fixed at **Three Shillings** per Quarter, *payable in advance*, by Penny postage stamps or otherwise. Subscribers in America may remit, either by post office order or in notes, 3½ dollars, in payment of one year's subscription, postage included.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON, 11, *Angel Court, Throgmorton Street, E.C.*, **not later than the 20th of the Month.**

The Astronomical Register.

No. 196. APRIL. 1879.

ROYAL ASTRONOMICAL SOCIETY.

Session 1879—80.

First Meeting of the new Session, March 14th, 1879.

Lord Lindsay, M.P., F.R.S., &c., *President*, in the Chair.

Secretaries—Mr. Glaisher and Mr. Ranyard.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected Fellows of the Society:

Maures Horner, Esq., 5, Bishopsgate Street Within, E.C.

E. E. Markwick, Esq., East Acton, Middlesex.

Arthur Edward Nevins, Esq., 3, Abercromby Square, Liverpool.

Charles Clement Walker, Esq., Lilleshall Old Hall, Newport, Shropshire.

Mr. Knobel was called upon to read a paper *On a Persian MS. of Ulugh Beigh's Catalogue of Stars*, recently presented to the Society by Mr. Ranyard. The MS. is in two volumes. The first consists of Ulugh Beigh's introduction to the catalogue of stars, and the second contains a pretty complete list of Ulugh Beigh's astronomical tables, among which is the catalogue of stars. Our knowledge of Uluh Bech's catalogue is derived from a translation made by Thomas Hyde in 1665. This translation was made from three MSS. at Oxford. Mr. Knobel had carefully translated the catalogue of stars in the MSS., in the possession of the Society, and had compared it with the translation of Hyde in 1665. He had found about 120 differences in the longitudes and latitudes of stars as given in this MS. and in the translation of Hyde. The Society's MS. is exceedingly useful in more ways than one. It not only acquaints us with a different reading of

Ulugh Beigh's catalogue, but the bad writing affords clues to explain discrepancies in other oriental MSS. Professor Newcomb has recently in the Washington observations investigated the records of certain Arabian eclipses given by Ibn Junis, and has found certain discrepancies he could not explain, but by means of investigating this Persian MS. Mr. Knobel has suggested explanations of some of these discrepancies which have probably arisen through bad writing in the originals. For instance, in one of the eclipses of the moon described by Professor Newcomb, according to Ibn Junis, the altitude of the moon is given as 66° when the eclipse began. Professor Newcomb found that that could not have been the case, because this altitude is much higher than the meridian altitude at the place of observation. It is impossible in any Arabic or Persian MS. to confound any number from 60 to 69 with any other number, that is to say, if you have the number 66 it may be a mistake for a number between 60 and 69, but it cannot be a mistake for 50, or 40, or 30. If you compare the properly formed Persian symbols for 60, 61, 62, 63, 64, 65, 68, 67, 68 and 69 there is a marked contrast between the numbers 66 and 62, but in the Society's MSS. the signs for these two numbers are so alike that it led Mr. Knobel to think that the mistake might have arisen from confusing these two numbers in Ibn Junis's MSS., and the probability of his surmise was added to by Mr. Neison, who computed that the altitude of the moon was really 62° 30′ at the time of the eclipse. There are five eclipses that Professor Newcomb has investigated, with respect to which Mr. Knobel has offered explanations suggested by the bad writing of the Society's MS. Any number from 10 to 19 is very likely to be confounded with the numbers from 30 to 39, and from 50 to 59.

Mr. Knobel's paper consisted chiefly of notes of different readings between the Society's MS. and Hyde's translation. He has also added a complete list of the magnitudes of stars given in the catalogue of Ulugh Beigh, who, following Ptolemy, gave the magnitudes in thirds, and by an initial letter indicated them as "large" and "small."

The President said: I do not know whether any Fellow of the Society can cope with the reader of the paper, but I am sure you will accord him your most warm thanks. It would be a matter of the greatest interest if a good collation of all the MSS. of Ptolemy's catalogue that are in this country and France could be made, giving the various readings. I wish Mr. Knobel would undertake the work.

Mr. Gill gave some explanation of a method for the determination of astronomical refraction. He said that when the ordinary

mode of determination was used by observing the zenith distances of stars at their upper and lower culminations, and finding the corrections of the assumed colatitudes and of refraction, the investigation became involved and included the imperfectly known law of refraction. A method, which was entirely independent of any assumed law, was therefore a desideratum, and he pointed out such a method in the case of an observatory exactly under the equator where stars selected also exactly on the equator might be observed by means of an altitude instrument at corresponding altitudes east and west of the meridian. If the right ascensions of the stars are accurately determined, we should then know the differences of their hour angles, as unaffected by refraction, and compare them with the differences as affected by refraction. The paper concluded with a summary of the conditions for the elimination of systematic errors.

Mr. Gill referred also to the results of his heliometric measures of the Mars stars, which indicated that all the right ascensions of faint stars observed with meridian instruments chronographically are too great, and that the right ascensions of stars of all magnitudes observed by the old eye-and-ear method appear to coincide precisely with the heliometric results. He suggested some causes of error, by which the observations by chronograph might be affected.

Mr. Marth said that the determination of refraction from meridian observations was not very uncertain, provided only proper precautions were not neglected. He gave some account of various determinations of the effect of temperature and refraction, and explained that, if the errors of the meteorological instruments were duly taken into account, the difference between the two determinations of refraction which Bessel had determined from Bradley's and from his own observations, was reduced to a quantity corresponding to a difference between the two thermometers of $0^{\circ}.4$ Fahrenheit. In concluding, he urged that the errors of the meteorological instruments ought to be strictly determined.

Mr. Christie remarked that as to the Greenwich instruments there was no necessity to give Mr. Gill any advice. It would be seen by the Greenwich volumes for many years past that the corrections of thermometer and barometer were carefully studied, and that the instruments were carefully compared with the standards, and he believed the maximum error of the thermometer was only one-tenth of a degree, and no one could profess to read a thermometer with greater accuracy than that.
tenth.

Mr. Neison showed on the board a ready method of determining

the differrence of error in observing the transit of a large and small star.

Mr. Gill thanked Mr. Marth for his suggestions, and corroborated Mr. Christie as to the great care that is taken at Greenwich in comparing the instruments. A recent comparison of the barometer with that at Kew was extremely satisfactory, a few thousandths of an inch being all the difference discovered.

Mr. Talmage read a paper entitled *Remarks on Mr. Sadler's paper in the January number of the Monthly Notices.* He said: Perhaps an apology is due to the meeting, as many other members older than myself might have brought this subject before the Society. I have received a number of letters on the subject from the friends of Admiral Smyth, and I will make one or two remarks of my own, and then read a letter I have received from Professor Piazzi Smyth, Director of the observatory at Edinburgh. The author of the paper says "that, unless he is mistaken, the President's Address was couched in eminently cautious language;" but he is mistaken. If he had been honest he would have given these words of the Astronomer-Royal, "My confidence in the exactness of the observations is purely personal. Knowing the attention which has been given to instrumental adjustment, &c., I can truly say, if an accurate observation were required, I should desire it should be made by Admiral Smyth, and in handing him the medal I beg leave to say that never was a medal more worthily earned." There is not much ambiguity in language like that, and the Astronomer-Royal in a letter to me lately says, "I had great confidence in Admiral Smyth's observations. The mistake is owing probably to *literary ardour and want of experience*, for he has been elected about two years, and this paper appears to have heralded his name on the Council list. I have received from Professor Piazzi Smyth a letter which he desires me to read. The letter stated in effect that—"No doubt a list of *errata* in the Cycle of Celestial Objects, if deduced from recent observations, would add largely to the value of the book, and would aid the progress of sidereal astronomy. Nor need there be any difficulty in accepting the criticism that in a book of such unique and comprehensive character as the Cycle, there must necessarily be a great deal left to be filled up by other men with more time at their disposal, and larger telescopes than the author of the Cycle had the opportunity of using. This was indeed abundantly explained by the author himself, and quite understood by his contemporaries, but instead of criticism of that common-sense kind, it was astounding to find that the author of the paper recently printed by the Royal Astronomical Society had made few or no observations himself, and made no pretence of being able to pro-

duce such a book as the Cycle himself, but had merely collected at the hands of two or three others, half a century after the Cycle had been published, and could now no longer be bought, a few corrections obtained in various countries by means of telescopes nine times larger than that used by Admiral Smyth. The author of the paper endeavoured, with persistent malignity, to ignore the very existence of all the better and complete observations in the Cycle. Such an attempt by any man to raise himself by vilifying others, and concealing all the main facts of the case, was in itself not merely disgraceful, but probably had never been heard of in this country since it had grown from its savage state." Mr. Talmage added that he was sure the sentiments contained in the letter would recommend themselves to any honest man. He had himself attended these meetings for 22 years, and had never before known of such an attempt to rise through dirt to dignity.

The President said: You have heard a paper read this evening which contains language considerably stronger than that usually heard in learned societies or at public meetings. The reason why I did not interfere during the reading of the paper was because, in considering the matter at the Council meeting this afternoon, we came to the conclusion that as an attack appeared to have been made upon the Council for allowing this paper to be printed in the *Monthly Notices*, it was desirable to court inquiry as much as possible, to show that we are not anxious in any way to stop investigation of the subject. Having said that I would invite discussion, but I hope speakers will, as far as possible, keep to Parliamentary language.

Mr. Knott said: It is not my wish to prolong the discussion, but I confess I read Mr. Sadler's paper with a great deal of pain. While Mr. Sadler has done good work in pointing out discrepancies in the Cycle, it seems to me that that is not the object of the paper, but the real object is to throw discredit and charges, I think I may say, of falsification, forgery, and fraud on a thoroughly honest and honourable man. (Hear, hear.) I had not the honour of an intimate acquaintance with Admiral Smyth, but I have corresponded with him, and met him at his own house, and no one who knew him could think he was anything else than thoroughly honest and honourable, an upright officer, and a gentleman. I think societies like ours have nothing to gain, but everything to lose, when the papers printed by them are marked by offensive personalities and insinuations of unworthy motives, and I hope after calling attention to the matter in this way we shall have no cause of complaint in the future. It seems to me to be still more to be deplored when the writer of the paper was, or was about to be made, a member of the Council.

Mr. Gill: I am sure the friends of Admiral Smyth will be glad to hear that the Council considered that this paper was simply intended to point out some of the errors which arise in everything that is done by human minds and human hands. When a catalogue has errors, and serious errors in some cases, it is worth while to consider how such errors may have arisen. They may arise fraudulently, or from want of care, from want of experience, or from various other causes. I would remind the Society of a notorious case of an imputation made against one of the most honoured workers in science we have had. When Sabine came back from his great magnetical series of observations, which he had made with a small circle and level, it was obvious that the value of his observations depended on the value of his level error. Captain Cator determined the value of his level error, and while Sabine's error gave one second of arc Cator's gave 10″. Babbage seized on this and made a violent attack on Sabine, and declared he must have forged the observations. Sabine went on a visit to Dr. Robinson, and Dr. Robinson did not know, as he afterwards said, whether to shake hands with Sabine or kick him out of the house. (Laughter.) But he determined he would get hold of the level and test it himself. He did so and found the error to be neither 1″ nor 10″ but 20″. The explanation turned out to be that the level was mounted in a brass tube, which by its expansion and contraction caused the error to change; when the tube was removed the error came out exactly as Sabine had determined it. Now, many of the errors in the Cycle may perhaps have some such origin, and I am sure the Society will wish to acquit Admiral Smyth from any act of dishonesty. If any man was jealous of his eyes and his telescope it was Admiral Smyth, for if anyone told him there was a faint star anywhere he would try and see it, and when he thought he had seen it he would measure it and publish the result, perhaps with the weight of I. attached to it, which he considered not of much worth. Among observers of double stars no one more honestly confesses than Struve that he makes errors, and if Struve errs I confess I think Admiral Smyth might have erred more times with his less experience, and therefore while the Society will acquit the memory of Admiral Smyth from any suspicion of dishonesty, I am sure Mr. Sadler will be the first to rise and say that he did not mean to impute dishonesty, but only some errors, and I hope that will be the result of the whole matter.

Mr. Neison: I think there is a great difference between the language of Mr. Sadler in his paper, and the interpretation put upon it by Mr. Talmage. There is no explicit charge of dishonesty. The most he says is that Admiral Smyth has followed his prede-

cessors errors. We do not find it stated or implied that Admiral Smyth forged these observations, or wrote down deliberately imaginary observations which he did not make. Those who have been accustomed to look for faint stars or satellites, know that they can easily fancy that they see them if they know where to look. I cannot see that Admiral Smyth has been charged with deliberate forgery, though no doubt he is charged with having made mistakes. There is in the paper a charge of having made inexplicable errors in the Bedford Catalogue, but it is in the form of a quotation from one of our best double-star observers, Mr. Burnham, of Chicago. The Cycle has been regarded with great trustworthiness, and its measures have been used for the purpose of determining double star orbits, and it seems there are numerous errors in it. I think it only fit and proper that they should be pointed out. In fact, most of us may be aware of doubts and difficulties and errors which have been introduced into double star work through its being assumed that Admiral Smyth's observations are to be implicitly trusted. (Cries of "Oh.") I may mention the supposed close companion to Procyon as an instance. I should be the last man to admit that Admiral Smyth would have done anything unbefitting the character of an English gentleman. But if errors are made by anybody—it does not matter who—I think it proper they should be pointed out.

Mr. Lynn: This sentence occurs in the paper in a note on one of the mistakes to which Mr. Sadler calls attention: "This statement is inexplicable if Admiral Smyth really examined the star."

Mr. Dunkin: As one of the older members of this Society, and one personally acquainted with Admiral Smyth, when such a charge is made by Mr. Sadler, and printed in the *Monthly Notices*, it is my duty, I think, to stand here and uphold Admiral Smyth's observations as far as I can. I am glad to hear it acknowledged on all sides that Admiral Smyth really was a gentleman—(laughter)—and, being a gentleman, that it was impossible he could forge his observations. Mr. Neison has said there is nothing in the paper on which we can found a complaint; but what does he understand by "the charge of a serious character" referred to by Mr. Sadler himself in the paper? With regard to these so-called inaccuracies, I have gone through them and I find they are mostly accidental errors that can be made with the greatest ease by any observer. I stand here as an observer of thirty or forty years experience; and I admit that I have made in that time scores of mistakes myself. I should be sorry if any gentleman who took up the Greenwich observations and analyzed them, and found some 10 degrees wrong in an observation, should say that I had forged the observations or copied them; yet

that is what has happened to the late Admiral Smyth. [Mr. Neison: I beg your pardon.] Now, take the first case of inaccuracy alleged in the paper. Admiral Smyth himself explained that error as due to a mistake in the reading of the micrometer. Then why should that be put here and held up against him? Then with regard to the next—a difference of 100 degrees in the position angle. What is that worth? It is a very easy mistake to make. Admiral Smyth while observing some faint object, and having scarcely any light in his room, reads off the position angle on his circle, and makes a mistake of 100 degrees. It is the easiest thing in the world to do. What is 100 degrees? I have made many similar mistakes. A young observer like Mr. Sadler, with his little experience, cannot understand mistakes of this kind, which older observers know they are liable to. Another paragraph in Mr. Sadler's paper grieves me to the utmost to think that it should ever have been allowed to be printed. I mean the paragraph which refers to Sir John Herschel's Reference Catalogue, edited by the Rev. R. Main and Professor Pritchard, of which he says, "As far as I am aware, there is one catalogue only, and that not an original one, which surpasses the Bedford catalogue in inaccuracy."

The President suggested that this was not a point at present under discussion.

Mr. Dunkin: Really, I think I may mention that point to show whether Mr. Sadler is qualified to know what is accurate and what is not accurate. (Laughter.) I only wish to say that the whole of the errors which Mr. Burnham discovered in the Herschel catalogue have been corrected in the Observatory copy, and the errata are remarkably few. If Mr. Sadler will come to Greenwich I will show him one of our standard catalogues, one of the most celebrated we have; and I will point out to him that where there is one mistake in the Herschel catalogue there are a hundred in the other; therefore, when Mr. Sadler says the Herschel catalogue is the most inaccurate that he ever knew, I must say his experience is not worth anything.

Captain Toynbee: My connection with the late Admiral Smyth makes me feel very warmly on this subject. I feel sure that all who knew him know that he was not the man to put down observations that he had not taken. The malicious way the charge is put is exceedingly bad; but Mr. Gill has told us how these mistakes may arise. I have been constantly living at sea taking nautical observations, and I know that we are liable to errors. It seems to me Mr. Sadler has commenced his astronomical life by "running a-muck" at the old astronomers. I am sure he cannot have intended to do what his words imply. It

seems to me like a midshipman of the present day pretending to get up and blame Nelson for not steaming fifteen knots an hour, and for not ramming the enemy's ships in Trafalgar.

Mr. Freeman: I have read the remarks with which Mr. Sadler prefaced his paper, and I think he has done good work for astronomical science, and has expressed himself on the whole temperately. Undoubtedly, the observations in the Cycle ought to be received with great caution. The result of the examination is that in the future the Celestial Cycle will either not be used at all, or will be used as corrected by Mr. Sadler. (Cries of "Oh!")

Mr. Christie: May I suggest that, instead of discussing this question from a personal point of view, it would be better for some one to go through Mr. Sadler's criticisms seriatim, and review them dispassionately, and see if they can be explained by any fair assumption as ordinary mistakes or blunders in observation. It must be remembered that to a large number of these errata Admiral Smyth gave the weight of which Mr. Sadler, quoting Admiral Smyth himself, says, means "nearly worthlessness." If Mr. Sadler brings forward those observations as casting reflections on the general catalogue, that matter might be fairly discussed without introducing any temper into the discussion, in order to show how much confidence we may place in these measures. I think out of 850 stars observed, Mr. Sadler has pointed out 40 errata, and against 20 of those he has affixed an asterisk, implying that the observations have been copied. Granting even that they have been copied, it is not a large percentage; but it is almost inconceivable that a man should risk his scientific reputation by copying 1-40th of the whole number of his observations, for that is really what it comes to. I have gone through several of the errata pointed out by Mr. Sadler. I don't see anything suspicious about them. They are the same sort of blunders I have found in examining the Greenwich observations. I have compared Admiral Smyth's observations with those of other observers, and I don't notice any discrepancy that seems at all suspicious. I did not approach the question with any prejudice whatever; but I thought I would fairly examine it, and that is the result of my partial examination. I hope, however, some Fellow will take up the question and discuss it thoroughly.

Mr. Chambers: Mr. Christie's suggestion is a good one, and I think may be acted upon; but at the same time it is due to the Society at large, and to the council, that we should come to some understanding on the subject, and that Mr. Sadler should offer some observations as to the real meaning and the bias of his paper, because, unless I am very dense, and other gentlemen are very dense and obtuse, on reading that paper I find that there is

a malignity about it, and an intention to impute dishonesty and fraud to Admiral Smyth, which, I think, under all the circumstances of the case, should be explained or withdrawn. No enquiry that may be made, in accordance with the suggestion of Mr. Christie, will be satisfactory to me, or to the Society, so long as what I take to be the clear and implicit and intentional imputations of fraud remain. I may be wrong, but if I am wrong Mr. Sadler will explain; but if there are such imputations of wilful misstatement, wilful deceit, and wilful fraud, they ought to be explained, justified, or withdrawn.

Captain Noble: My own experience of the Cycle may be briefly summed up in this—that its star magnitudes formerly led me to find more mare's nests in the heavens than any other work I ever opened. I believe its magnitudes to be almost utterly untrustworthy. I should not have made any reference to volume 40 if Mr. Dunkin had not done so. If instead of saying it was the most inaccurate double-star catalogue ever printed, Mr. Sadler had said it was the most useless, I do not think any man in the room would have held up his hand against the assertion.

The President: Does any gentleman wish to make any further remarks?

Mr. Talmage said he held in his hand several letters with a discretion to read them, or not; but he was satisfied with the discussion that had taken place, and, with the permission of the meeting, would withdraw his paper. The purpose of Professor Piazzi Smyth had been thoroughly accomplished, and he believed that if the Society could be polled, almost to a man they would say that Admiral Smyth was an honest man. (Cheers.) That was all he wished to have affirmed.

The President explained that a paper could not be withdrawn, though it need not be printed.

Mr. Chambers thought the Society ought to insist on the paper being printed. It was a fair and temperate explanation, and a perfectly fair and reasonable defence of Admiral Smyth by his son. I should be sorry to see it not printed.

Mr. Ranyard: I think the Society is agreed on two or three points: first, that Admiral Smyth performed very great services for astronomy; that as a popular writer he interested a great many men of the past generation in astronomy, and the Society is also I think agreed that it is of very great importance that free and honest criticism should be encouraged, whether it comes from a young man or from an old man. The only question with regard to which there is any difference is, whether in this case there is any malice about the criticism. In passing this paper it is evident that the Council felt that that was no malice sufficient

to justify them in refusing to print the paper. I greatly regret that so much warmth should have been exhibited, for such discussions, though begun without malice, may lead to evil consequences.

The President: The question of criticism is one of great and vital importance to our Society. I cannot help thinking that had the paper of Mr. Sadler been devoted to a mere numerical list of the errata, or corrections, of the observations to be found in the "Cycle," though it would be dry to read, it would have been extremely useful, and might have been adopted probably in any new edition of the book. Such a list of errata might have been prepared without imputing any motives, or giving any reasons for the corrections. In correcting a table of logarithms you would not think of putting any reason for altering a figure 8 to figure 9. If Mr. Sadler would give his attention to corrections as Prof. Argelander did of the various catalogues that we have, it would be an extremely valuable service, and no one would value such tables of corrections more than myself. I would suggest that he should take up the B. A. catalogue (laughter). I think the discussion brought about by Mr. Talmage's paper is one of value to the Society, as it is a decidedly good thing to have a ventilation of opinions. I never had the pleasure of the acquaintance of the late Admiral Smyth, but I must say of his book that it was one of the first astronomical books I ever read; and I remember the delight I felt in reading it, it did more to make me turn my attention to the subject than any other book, and I believe I am not a solitary instance, for I know of no book that has done more to interest amateurs in astronomy than that (applause).

Captain Toynbee: I am glad, my Lord, to hear you say that; and I would suggest that your speech be entered on the minutes of our Society, to counterbalance what has been already published. It would, I am sure, be satisfactory to Admiral Smyth's friends.

The President: I do not know whether Mr. Sadler desires to say anything.

Mr. Sadler: No, my Lord; except simply that I have not imputed dishonesty to Admiral Smyth. I think my remarks were legitimate criticism. I have the right to point out errors, and it is quite possible that Admiral Smyth may have made mistakes.

Captain Toynbee: But if a clever man has made a mistake you need not call him a liar.

Mr. Sadler: In an observation that Herschel gives as 320°, Admiral Smyth follows him $320\frac{1}{10}°$. There is a mistake possibly. The actual figure ought to be 220°. If such mistakes

are to be found, not once or twice, but many times, surely we must infer that Admiral Smyth must have been influenced or biassed by the previous observations. Mr. Christie has referred, I think, to M. Flammarion's valuable book on double stars. In that book there is a statement giving a proper motion to a certain star of 0·9 seconds per annum, on the authority of one of Admiral Smyth's observations, an observation which is perfectly erroneous, because it rests on a certain observation of Herschel's, in which the error is perfectly explicable.

Mr. Christie: With regard to Flammarion, I don't think he does accept Admiral Smyth's measures implicitly. He shows, I think, regard to the proper motion of the star referred to, that Admiral Smyth's measures were not erroneous, there would result a proper motion of 1″ in the star.

Dr. Copeland: I think I can explain to the meeting how mistakes of the class pointed out by Mr. Sadler are easily made. A man observing double stars wants to compare with Sir John Herschel, and runs down a list to find the position angle. He has the figure on 173, but compares with Herschel's 137 and thinks that he must have made some large error—by a slip—and alters it; this is a source of error which many an old observer will be aware of. I wish, therefore, to point out that because an observer has copied an error he must not be charged with committing a fraud. As has been said, it is perfectly absurd that any man who has produced a work like the "Cycle" should have forged 1-40th of his observations. Look at the corrections that Argelander has made, and the thousands of corrections others have made; but they never think of throwing the slightest stain on the character of the observer. As this paper has conveyed to all who have read it the impression that it does impute fraud to Admiral Smyth, I think the Society owes it to itself to put something in print in the *Monthly Notices* on the other side, showing that we do not agree with that statement.

Mr. Common: There can be no doubt about the errors which Mr. Sadler has pointed out, but that correction of itself has not given rise to this feeling. The real question is the motive that has been manifested, or is supposed to have been imputed. If Mr. Sadler is prepared to withdraw any imputation of bad faith on Admiral Smyth, the matter, as far as I can see, should be at an end; and the ground would be cut from under the feet of the people who have objected to his criticism.

Mr. Sadler: It is simply impossible to deny the imputations. I have given the grounds for them in my paper. I must stand or fall by them.

Mr. Ranyard: What you have said may be interpreted by the

Fellows in any manner they choose. You have not definitely said that you imply no bad faith.

Mr. Sadler: Nor do I do so; but I have said that there is a remarkable coincidence between these observations and others, and I do not think that anyone can interpret that into an imputation of dishonesty.

Mr. Gill: Then just say that you did not impute dishonesty.

Mr. Sadler: I do not impute it. If I attacked an observation by Lord Lindsay I should not impute dishonesty, even if I pointed out that his observation was like others. I might be said to impute a bias, but that is not saying that he copied. I do not say, and never have said, that Admiral Smyth did not observe the stars.

Mr. Christie: You do distinctly say he copied other people.

The President: I must request that observations be addressed to the chair.

Mr. Christie: Mr. Sadler does distinctly say that Admiral Smyth copied these observations which he has marked with an asterisk; and I do not see how Mr. Common's suggestion can be carried out, because the whole paper stands or falls on that point.

Mr. Neison: Mr. Sadler does not say "copied." He says "followed." I don't see, after what Mr. Sadler has said, that it ought to be assumed that he made any imputation. There are certain words in this paper that I should not interpret as other gentlemen have done. Some of them may bear a certain interpretation, but I understand we have now an explicit assertion that that interpretation was not meant; and what more can be desired?

Mr. Christie: If Mr. Neison had read the paragraph he would have seen that Mr. Sadler says of Admiral Smyth: "in cases where he has presumably 'copied' the measure of others."

Mr. Sadler: I certainly desire to withdraw the word "copied" and to say "followed."

The President: The question before the meeting is that this paper be withdrawn.

Mr. Penrose: It is impossible to acquiesce in the desire to withdraw the paper, unless something more explicit is given by or on behalf of Mr. Sadler that the insinuation which is made is also withdrawn. If he does not do that, I think something should appear in the records of the Society denoting that it is not the opinion of the Society with regard to Admiral Smyth that he palmed off the observations of other people as his own.

Mr. Ranyard: I think the Society is not understood to endorse every statement in the papers they publish. It is well for the purpose of criticism that great latitude should be allowed to critics

as well as to those who defend from criticism. The Society has not in any way pledged itself by any assertion or insinuation made in Mr. Sadler's paper. The council has allowed many papers to be printed during the last few years which no one would suppose they wished to endorse. It cannot be said that Mr. Sadler's language was sufficiently unparliamentary to prevent the paper being printed.

Mr. Talmage drew attention to a paragraph in page 191 of the *Monthly Notices* where Mr. Sadler had said that Admiral Smyth had given the colour of a star he could not have observed. He (Mr. Talmage) did not object to criticism, but objected to the imputation of motives.

The President then put the question whether Mr. Talmage's paper be printed or not; and on a show of hands, it was resolved that it should be printed.

Professor Langley said he had been deputed by the United States Coast Survey to make observations in Europe on the character of astronomical vision at different altitudes. About Christmas he was located on the slopes of Mount Etna; and his observations led him to believe that the advantages of mountain-stations had been exaggerated as regards their work for precision; but as regards light, and the visibility of faint objects, there were great advantages. Though his eye was not sensitive to faint objects, he found he could see with the same apertures there what better observers than himself had seen here. In the clear atmosphere of Sicily, near to the sea level, he was able to count distinctly but six stars of the Pleiades; but at this station, half way up Etna, he easily counted nine stars, and glimpsed almost as many more. As regards faint objects, like nebulæ, the gain was very marked, and also there were evidently great advantages, for all work connected with solar physics, especially for viewing the lines of the chromosphere, the gain was enormous. It was hardly too much to say that the future of solar physics was very largely bound up in the question of observatories in a more elevated atmosphere. He had supposed from his experience in the Rocky Mountains and in some of the Southern States, as well as in Egypt and Italy, that he was justified in coming to the conclusion that, for solar work, they wanted very dry climates as well as an elevated region; but on coming here an observer of greater experience than himself had pronounced in favour of a climate where the air was saturated with moisture, when not actually cloudy. On this point he should be glad of an expression of opinion by members of the Society.

Mr. Brett observed that Professor Langley had said very modestly that his eye was not remarkably sensitive to delicate objects; but Professor Langley had seen Mercury on the corona several

minutes from the limb, and could see the corona for fifteen minutes from the limb in bright daylight; a thing which, when he (Mr. Brett) stated it to this Society some years ago, produced general laughter.

Professor Langley: I have not seen it in bright daylight.

Mr. Gill: But you have seen it?

Professor Langley: I think I have seen evidences of the corona in daylight. On the occasion of the transit of Mercury I believe I saw Mercury just before it reached the limb, which seemed to me to be evidence of some kind of background.

Mr. Christie said that Professor Tachini had frequently seen the corona and a large portion of its streamers.

Mr. Ranyard had seen Tachini's drawings, and they were very unlike what we knew the corona to be from eclipse observations. It was possible that Mercury might have been seen by reason of light transmitted through its atmosphere. A crucial test was whether the moon could be seen on the background of the corona. He did not think that the moon had been seen before it came up to the sun's disk, and it was questionable whether any part of the moon's limb could be seen outside the sun when the sun was partially eclipsed. His own conclusion was that it had occasionally been seen, but only for a minute or so outside the limb, and possibly that was when the moon was passing over prominences.

Mr. Neison: Is it not possible that Professor Langley saw Mercury by reason of its atmosphere reflecting or refracting the solar light? In the case of the transit of Venus that was seen 36 hours before the transit.

Professor Langley: The circumstances under which I saw Mercury were altogether exceptional. There was the bluest sky at the moment of first contact that I had seen in the year, perhaps, and the reason, I believe I was not biassed, was that I was using a polarizing eyepiece, which entirely changed the position angle, so that I was not sure within 30° of the place upon the limb. When I saw the planet almost in contact with the limb, apparently as a darker spot on something a little brighter, I very deliberately revolved the eyepiece in order to make certain that this was no speck of dust, and I arrived at the conclusion that whatever it was it was something real. Immediately after I saw the limb notched at this point. Under these circumstances I can hardly doubt that the observation indicated something sufficiently bright to serve as a background.

The President: I think the Society will be grateful to Professor Langley for giving them an instance, so well recorded, of a very rare phenomenon. Such an authentic statement will be very valuable.

Mr. Ranyard: With such a very faint object, it would no doubt be difficult to speak with certainty as to whether the inside of the spot was darker or brighter than the outside area. The observer would be conscious that a circular area was marked out in some manner, but it might be by a ring of light corresponding to the limb of the planet, and unless special attention were paid to this I think we must not rely on such an observation, as proving that the disk of the planet was darker than the surrounding area.

After a vote of thanks to Professor Langley, the Meeting adjourned at half-past ten.

REVIEW.

Description of Observatory at Higher Bebington, Cheshire. A Paper read before the Literary and Philosophical Society of Liverpool, March 18th, 1878. By R. C. Johnson, F.R.A.S. pp. 8.

This neat and compact observatory, of which a woodcut is given, is of two stories; the lower one, circular, made of bricks or stone (?) enables the telescope to be raised above surrounding objects, and is utilised for a laboratory or photographic room. The upper equatorial room is of the *drum-dome* form, also circular; all but the lowest foot being a continuation of the wall of the lower room, and is made of timber covered with corrugated zinc. Mr. Johnson describes some novel improvements in this dome which works well. The telescope is an equatorial reflector by Mr. John Browning, with silvered-glass speculum of 9¼-in. diameter and 6-ft. 6-in. focus, of excellent performance, both for space-penetrating power and for the manner in which it divides the closest double-stars. The pier which supports it rises from a firm foundation, and is carried through without touching either of the floors. It is hollow in the centre and open down part of one side, so that a well-ventilated space is allowed for the fall of the weight of the driving-clock. We congratulate Mr. Johnson on the erection of this observatory, and wish him health and every facility for doing useful work with it.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

To all communications must be annexed the name and address of the sender, as a guarantee of good faith.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

NAMES ON MAP OF MOON.

Sir,—Amongst the names which Mr. Neison fails to identify is one, "Mösting." I should think this was intended for Möstlin, of Tübingen, the discoverer of the comet of 1580.

Your obedient servant,

Eastbourne: March 1, 1879. G. F. CHAMBERS.

THE NOMENCLATURE OF MARKINGS ON MARS.

Sir,—You ask me to write about the Mars-marking controversy. I think it is a mistake to have a *controversy*. It seems to me by creating party feeling to be the surest means of preventing any practical result. The question can only settle itself when, party feeling on the subject having been forgotten, a map of Mars, so superior to all others in convenience and accuracy, appears, that by its simple merits alone (like Beer and Mädler's map of the moon) it becomes a standard of reference without controversy. The matter, therefore, I think, should be left to the judgment of the man who may be successful in producing a map that shall *command* the position of authority.

I am, Sir, your obedient servant,

DAVID GILL.

NAMES OF MARKINGS ON MARS.

Sir,—While the nomenclature of recently-discovered (or recently determined) detail upon the surface of the planet Mars may reasonably be a subject for discussion, I must say that I am entirely in agreement with Mr. Green as to the impolicy of disturbing that for which we are indebted to Mr. Proctor, and which has now become so firmly established. If it were only that Mr. Proctor's names have been adopted by our admittedly chief authority on the subject, Dr. Terby, of Louvain, this would, I conceive, afford ample reason why they should not be altered, even did no others exist.

Every practical observer must, I think, endorse Mr. Green's assertion that the association between an object and a name is much more direct and immediate than that between such object and a number or symbol. Speaking for myself, "Dawes Ocean" and "Kaiser Sea" recall images to my mind which I certainly venture to think B^4 or ζ^8 would entirely fail to do. Nor do I, I confess, see that objection to the use of the names, even of living astronomers, which seems to strike some of your correspondents—always assuming that such astronomers have contributed to our knowledge of areography. I do not remember ever to have heard any condemnation of such names as Hudson's Bay, Davies' Straits, Behring's Straits, Torres' Straits, Marshall's Islands, Parry Islands, Kerguelen's Island, &c., &c., as applied to terrestrial objects, and I wholly fail to see upon what principle exception can be taken to naming parts of the surface of Mars after observers and others who have done so much to advance our

knowledge of the planet as Dawes, De La Rue, Lockyer, Phillips, Proctor, Terby, and many others.* Nay, in the perfectly exquisite drawings made by Mr. Green himself at Madeira in 1877 (than which, I have no hesitation in saying, nothing finer has ever yet been executed) I can find ample justification for calling at least one tract, "Greenland." Under any circumstances, however, I think that it would be better even to number Martial objects 1, 2, 3, 4, and so on, than entirely to alter existing nomenclature, in the way done by M. Flammarion and Signor Schiaparelli; the work of which latter astronomer especially I can only regard as mischievous, and as tending to create wholly needless confusion.

I am, Sir, obediently yours,

Forest Lodge, Maresfield, Uckfield: March 18, 1879. WILLIAM NOBLE.

Sir,—In your February number I see that Lord Lindsay proposes to return to Mädler's method of distinguishing between the different markings on Mars, and to designate them by different number of the alphabet. I think there are in practice grave reasons against adopting such a course, and especially the great difficulty in remembering such a system. Continent A, Marking little b, Gulf large C, &c., &c. These give absolutely no assistance to the memory, and often prove most treacherous through one letter being confounded for another of a similar sound. These letters are in my own experience harder to remember than even letters, yet in the cases of both the moon and the minor planets we have instances of how much easier it is to remember names than numbers.

If we were beginning *de novo*, I should strongly support Lord Lindsay's alternative method, namely, that the names should be drawn from the male members of the ancient mythology, for I

* In speaking as I have done above of the nomenclature of geographical details, and of assigning to different localities on the earth the names of their discoverers, I have not overlooked what Lord Lindsay has said upon p. 46. It seems to me, however, that the discovery of any fresh areographical feature renders it, in one sense, a portion of the scientific possessions of the nation in which it may happen to be made. We are in the last degree unlikely to go to war either with the Belgians or the Italians to obtain a "scientific frontier" in Mars, and I myself cannot see any valid objection to Cape Schiaparelli, or to Terby Sound, upon a map of the planet. It would not wound *my* national susceptibilities in the very smallest degree to find those names there, and it seems difficult to me to imagine that men of other nationalities should be more sensitive with reference to a form of nomenclature which must possess a certain amount of historical value, as connecting various details upon Mars with the names of those who first detected them.

think on all grounds this is the most advantageous system. Associate them with terrestrial analogies, as *Lacus*, *Promontorium*, *Terra*, and you have, I think, the easiest system of nomenclature of all to be remembered.

For the present, however, I think it would be far from advantageous to alter the common system of nomenclature. When the principal markings on Mars have had their shape ascertained with some approach to accuracy, then it will be time enough to frame a lasting system of nomenclature. To give a name to some great division, and then to find it is divided into three, or to separately name two great divisions, and find that they are really one, is to introduce frightful confusion into a systematic standard notation, whereas it does not matter at all in the present haphazard nomenclature, which no one attempts to learn unless he is systematically observing Mars, and if he be doing so he will certainly not be content until he has learnt all.

To introduce another provisional system would merely make the present confusion worse, and would be useless. Unquestionably Proctor's system of nomenclature is the oldest, and the one most commonly used. Why not retain it until we have some accurate knowledge of the principal divisions of the surface of Mars, and then issue a map and monograph of the planet with a system of nomenclature derived from the mythological dictionary?

E. NEISON.

AN OBSERVATORY OF THE TENTH CENTURY.

Sir,—I have just come across an extract from the Chronicon of Bar Hebræus which may be interesting to some of your readers. I append a translation, merely observing that Bar Hebræus, better known to us by the name of Gregory Abu'lfaragius, was born in 1226, A.D., and is of great authority as an historian of the east:

"Now in the year 378* Sharph'odaulah gathered together the philosophers that were in the dominion of the Arabians, and built a tower for observing the movements of the stars, and established instruments (the Syriac word is *organs*) of observation and circles of brass, as Mamun also had done in his days. And he appointed over the work Abu'sahel, son of Rhustham of the mountain district."

Tunbridge Wells:
Feb. 18, 1879.

I am, Sir, faithfully yours,
GEORGE B. HOWARD.

* *i.e.* of the Arabians, corresponding to A.D. 986.

ASTRONOMICAL OCCURRENCES FOR APRIL, 1879.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Tues	1	9 37	Occultation of θ Cancri (6)			β Leonis —
		10 40	Reappearance of ditto			11 3·2
Wed	2		Sidereal Time at Mean Noon oh. 41m. 50·228.			10 59·3
Thur	3	11 46	Occultation of B.A.C. 3529 (6)			
		12 39	Reappearance of ditto			
		12 56	Occultation of 43 Leonis (6)			10 55·3
		13 17	Reappearance of ditto			
Fri	4	11 50	Occultation of p^1 Leonis (5)	1st Tr. E.	16 25	
		12 49	Reappearance of ditto			10 51·4
Sat	5		Sun's Meridian Passage 2m. 48·79s. after Mean Noon			10 47·5
Sun	6	10 24	○ Full Moon	3rd Oc. R.	17 4	40 43·5
Mon	7					10 39·6
Tues	8					10 35·7
Wed	9	11 8	Near approach of B.A.C. 5347 (5)			
		0	Conjunction of Mars and ι Capricorni 0° 5′ S.			10 31·7
Thur	10		Saturn's Ring: Major axis=35″·89 Minor axis= 4″·50			10 27·8
Fri	11			1st Tr. I.	16 5	10 23·9
Sat	12	15 17	Occultation of χ^2 Sagittarii (6)			
		16 29	Reappearance of ditto			10 19·9
Sun	13	2 9	☾ Moon's Last Quarter	3rd Ec. R.	17 9 35	10 16·0
Mon	14					10 12·1
Tues	15	8	Conjunction of Moon and Mars 3° 24′ S.			
			Illuminated portion of disc of Venus=0·848			10 8·1
			Illuminated portion of disc of Mars=0·886			

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage
		h. m.			h. m. s.	h. m.
Wed	16	12	Conjunction of Moon and Jupiter 4° 6′ S.			β Leonis
		23	Inferior conjunction of Mercury and Sun			10 4·2
Thur	17		Sidereal Time at Mean Noon 1h. 40m. 58·53s.			10 0·3
Fri	18		Sun's Meridian Passage 0m. 38·40s. before Mean Noon	1st Sh. I.	16 58	9 56·3
Sat	19	11	Conjunction of Moon and Saturn 7° 32′ S.			6 52·4
Sun	20	16	Conjunction of Moon and Mercury 4° 31′ S.			9 48·5
Mon	21	1 55	● New Moon			9 44·5
Tues	22					9 40·6
Wed	23	9 29	Occultation of 23 Tauri (5)			9 36·7
		9 41	Reappearance of ditto			
Thur	24	0	Conjunction of Venus and υ^1 Capricorni 0° 8′ S.	3rd Tr. E.	16 5	9 32·7
		3	Conjunction of Moon and Venus 2° 43′ S.	4th Oc. R.	16 44	
Fri	25					9 28·8
Sat	26			1st Ec. D.	16 2 20	9 24·9
Sun	27			1st Sh. E.	15 41	9 20·9
Mon	28					9 17·0
Tues	29	2 16	☽ Moon's First Quarter			9 13·1
		18	Conjunction of Neptune and Sun			
Wed	30	9 56	Occultation of B.A.C. 3398 (6)			9 9·1
		10 30	Reappearance of ditto			
			Saturn's Ring : Major axis=36″·30 Minor axis=″5·20			
MAY						
Thur	1			3rd Sh. E.	15 25	9 5·2

THE PLANETS FOR APRIL.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury...	1st	1 46 23	N.14 7	8″·2	1 8·3
	9th	1 52 5	N.14 50	10″·2	0 42·5
	17th	1 35 19	N.11 34	11″·6	23 50·4
	25th	1 21 13	N. 7 49	11″·4	23 4·9
Venus ...	1st	2 27 2	N.14 40½	11″·6	1 48·1
	9th	3 5 14	N.17 57	12″·0	1 55·5
	17th	3 44 30	N.20 44	12″·4	2 3·2
	25th	4 24 47	N.22 56	12″·8	2 11·9
Mars ...	14th	21 32 29	S. 16 2	7″·2	20 0·1
	24th	22 1 21	S. 13 44½	7″·6	19 49·5
Uranus ...	3rd	10 11 45	N.12 1	4″·2	9 24·4
	19th	10 10 22	N.12 8	4″·2	8 20·1

Mercury is well situated for observation at the beginning of the month, setting nearly two hours after the sun, the interval decreasing. At the end of the month he rises about twenty minutes before the sun.

Venus sets about two hours and a half after the sun, the interval increasing to three hours and a quarter on the last day.

Mars rises about an hour and three-quarters before the sun, the interval increasing.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN APRIL, 1879.

BY W. R. BIRT, F.R.A.S., P.S.S.

The Rev. W. J. B. Richards suggests that certain lunar objects, suspected of change, should be regularly observed. He has handed me a list of eighteen such objects, from which I propose to make a selection for my present list, premising that he recognises three classes: the first comprises those objects that have changed in appearance and form since they were observed by earlier selenographers. The second class contains objects more strictly variable, *i.e.*, change from time to time, either in form or tint, the variation depending upon alterations in the angle of illumination, or other causes unknown. The third class includes objects seen as *bright* points on the unilluminated part of the moon.

For variation in size, measurement is essential, estimation of size or comparison with other objects in the neighbourhood will only give the relative variation. In the series of drawings in the vicinity of Hyginus by Mr. Rand Caprom, published in the *English Mechanic*, Feb. 28, 1879, p. 605, the Rev. W. J. B. Richards estimates the amount of variation in size of Klein's crater to be nine times the extent of Hyginus on Jan. 4, 1879. On March 1, 1879, Capt. Noble recorded Klein's crater as "scarcely if at all larger than Hyginus itself."

For observation in April. *Linné*, its general appearance and form, measurement of its greatest and least diameters, position of its interior craters. Does it present the appearance of a cone? *Messier* and *Messier A*, relative sizes and shapes, direction by alignment of lucid streaks. Are they on or above the moon's surface? number and position of craterlets

seen *in* the streaks. *Posidonius* γ, comparison of brightness with Linné, minute crater opening on its summit. *Billy*, tint of floor, number and distribution of white spots on the floor. *Bright spot west of Picard*, measurement of longest and shortest diameters, distance of eastern edge from western edge of Picard, aspect at sunrise, at midday, at sunset, craterlets on its site. Order of brightness of following objects: *Censorinus*, *Proclus*, *Dionysius*, *Polybius A*, *Rosse*. This order of relative brightness was recorded on August 3, 1876. Does the same order obtain now? It is especially important to determine the relative brightness of these objects at the present time.

Water Lane, Stratford, E.:
March 11, 1879.

VARIABLE STARS, APRIL.

Approximate times of minima and maxima, according to Schönfeld and Winnecke.

1879.	G.M.T. h.			mag.	R.A. h.	m.	s.	1855. °	′	Decl. ″
April 3	6·2	Algol.	min.	4	2	58	45	+ 40		23·6.
4	6·8	U Coronæ	min.	9	15	12	17	+ 32		10·8.
—		S Ophiuchi	max.	9	16	25	55	— 16		51·1.
7	14·4	δ Libræ	min.	6	14	53	14	— 7		56·4.
—		R Cygni	max.	7	19	32	56	+ 49		52·5.
14	13·9	δ Libræ	min.	6						
—	15·4	U Coronæ	min.	9	15	12	17	+ 32		10·8.
—		T Herculis	min.	12	18	3	27	+ 30		59·9.
15		R Aquilæ	max.	7	18	59	23	+ 8		0·8.
17		R Draconis	max.	6·5	16	32	17	+ 67		3·5.
—	14·3	Algol	min.	4						
19		U Virginis	min.	12·5	12	43	45	+ 6		20·6.
—		R Vulpeculæ	min.	13	20	57	56	+ 23		14·9.
20	11·1	Algol	min.	4						
—		R Virginis	min.	11	12	31	9	+ 7		47·2.
21	13·0	U Coronæ	min.	9	15	12	17	+ 32		10·8.
—	13·5	δ Libræ	min.	6						
22		R Sagittæ	min.	10]	20	7	27	+ 16		17·4.
23	7·9	Algol	min.	4						
28	10·7	U Coronæ	min.	9	15	12	17	+ 32		10·8.
30		R Leonis	min.	10	9	39	45	+ 12		5·9.
May 1		S Ursæ maj.	min.	11	12	37	35	+ 61		53·3.

SATELLITES OF URANUS.

Major and minor semi-axes a and b of the apparent ellipses described by the satellites, and position-angles p_o of the major axes:

1879.	Ariel. a	b	Umbriel. a	b	Titania. a	b	Oberon. a	b	p_o
	″	″	″	″	″	″	″	″	°
April 5	15·04	3·91	20·95	5·45	34·36	8·94	45·95	11·96	12·41
15	14·93	3·94	20·80	5·49	34·12	9·01	45·62	12·05	12·36
25	14·81	3·95	20·63	5·50	33·84	9·03	45·26	12·07	12·32

In these apparent orbits the satellites move in the direction of decreasing position-angles, from their greatest northern elongation N. (in position angle 12°·4) to inferior conjunction (pos. 282°·4), greatest

southern elongation S. (pos. 192°·4), superior conjunction (pos. 102°·4), etc. The satellites will be at these points of their orbits about the following hours, G.M.T.:

Ariel.			Umbriel.			Titania.			Oberon.		
1879.	h.			h.			h.			h.	
April 1	12	S.	April 1	0	N.	April 1	2	S.	April 3	12	N.
2	19	N.	3	2	S.	3	6	sup.	6	20	inf.
4	1	S.	5	4	N.	5	11	N.	10	5	S.
5	7	N.	7	5	S.	7	15	inf.	13	14	sup.
6	13	S.	9	7	N.	9	19	S.	16	23	N.
7	20	N.	11	9	S.	11	23	sup.	20	7	inf.
9	2	S.	13	11	N.	14	4	N.	23	16	S.
10	8	N.	15	12	S.	16	8	inf.	27	1	sup.
11	14	S.	17	14	N.	18	12	S.	30	10	N.
12	21	N.	19	16	S.	20	16	sup.	May 3	19	inf.
14	3	S.	21	18	N.	22	21	N.	Ariel.		
15	9	N.	23	19	S.	25	1	inf.	April 24	5	S.
16	16	S.	25	21	N.	27	5	S.	25	11	N.
17	22	N.	27	23	S.	29	9	sup.	26	17	S.
19	4	S.	30	1	N.	May 1	14	N.	28	0	N.
20	10	N.	May 2	2	S.				29	6	S.
21	16	S.							30	12	N.
22	23	N.							May 1	18	S.
										A. M.	

Books received.—New Solar Elements. By G. T. Carruthers. Nagpur. 1879.—Meteorological Observations made at the Adelaide Observatory, 1876, 1877. Adelaide: E. Schiller. 1878.—Passage de Mercure devant de soleil, 1878. Par Ad. de Boë. Anvers. 1879.—Bibliographie de Spectroscopie. Par Ch. Fiévez. Bruxelles: F. Hayez. 1878.—Annuaire de l'observatoire Royal de Bruxelles. F. Hayes. 1878.—Testimony of the Stars. By Frances Rolleston. Rivingtons. 1879.—End on Illumination in Private Spectroscopy. By Piazzi Smyth. Edinburgh: Neill & Co. 1879.—Annual Report of the Director of Harvard College Observatory. By Professor E. C. Pickering. Cambridge: Wilson & Son. 1879.—First Lecture on the Circle and Straight Line. By J. Harris. 1879.—Report of the Observations of Solar Eclipse, July 29th, 1878, made at Fort Worth, Texas. Cambridge. 1879.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To March, 1879.
Hills, H.
Jackson-Gwilt, Mrs. H.

To June, 1879.
Elliott, R.
Gray, T. P.
Tupman, Captain

To August, 1879.
Burton, C. E.

To October, 1879.
Warner, T.

To Dec., 1879.
Abbott, F.
Freeman, A.
Herschel, Prof. A. S.
Markwick, E. E.
Perigal, H.
Whitbread, S. C.

To March, 1880.
Riddiford, G. F.

To April, 1880.
Fry, E. A.;

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage to all parts of Great Britain and Ireland) is fixed at **Three Shillings** per Quarter, *payable in advance*, by Penny postage stamps or otherwise. Subscribers in America may remit, either by post office order or in notes, 3½ dollars, in payment of one year's subscription, postage included.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. Jackson, 11, *Angel Court, Throgmorton Street, E.C.*, **not later than the 20th of the Month.**

The Astronomical Register.

No. 197. MAY. 1879.

ROYAL ASTRONOMICAL SOCIETY.

Session 1879—80.

Second Meeting of the Session, April 9th, 1879.

Lord Lindsay, M.P., F.R.S., &c., *President*, in the Chair.

Secretaries—Mr. Glaisher and Mr. Ranyard.

The minutes of the preceding meeting were read and confirmed.

The Rev. Abraham Smith, of the Collegiate School, Huddersfield, and

Mr. Lewis Swift, of Rochester, U.S. America,

were balloted for and duly elected Fellows of the Society.

Mr. Glaisher announced that 65 presents had been received since the last meeting, and the thanks of the Society were formally voted to the donors.

The President: I regret to have to announce the death of M. Edmond de Chazal, of Mauritius. I feel I shall be pardoned for publicly recording my feelings with regard to him. I do not wish to speak of him as a personal friend, for whom I had the highest esteem, but as a citizen of the world who gave me great assistance in establishing my observatory for observing the transit of Venus, and who afterwards placed, by deed of gift, the site of the observatory which I raised on the island in the hands of the government. The interest he took in my work was only equalled by his personal kindness during my illness.

Mr. Ranyard read a paper by Dr. Dreyer on an apparently new variable star which appeared to be identical with the red star Schjellerup 109.

Mr. Ranyard read a paper by M. Trouvelot *On the presence of absorbing masses in front of the photosphere.* On several occasions during the years 1872 and 1873, M. Trouvelot had, while observing with the spectroscope at Harvard College Observatory, noticed dark masses which cut out the light in the neighbourhood of the C line. On looking at the same part of the photosphere he could perceive no traces of any dark object, and he was led to conclude that there must be absorbing matter floating in clouds above the photosphere, which only absorbed the particular wave length cut out from the spectrum. According to his observations these clouds are not evanescent objects, but remain in some instances from day to day.

Mr. Ranyard said he did not know whether any other spectroscopic observers had seen similar absorption areas on the surface of the sun. They appeared, according to the description, to be much more than the indistinct cloud-like markings to be seen on M. Jannsen's photographs, which seem to alter very rapidly.

The President: It is a curious subject, and one well worthy of attention from those who devote themselves to the spectroscope. At the same time I think it is a pity that M. Trouvelot never seems to have called on anybody at the Harvard Observatory who could come and look through the instrument, and check these remarkable observations. The paper would have been much more interesting if M. Trouvelot had taken such precautions, and had shown that there could be no illusion about his observations.

A vote of thanks was passed to M. Trouvelot.

Mr. Common read a paper entitled *Notes on large telescopes, and suggestions for mounting reflectors.* He said that, after considering the various forms of instruments that it was open to him to construct, he had by a process of selection arrived at the conclusion that the silver-on-glass reflector, on the Newtonian principle, was the only form which would be feasible for the construction of a large instrument. His paper was listened to with some interest, as it is known that he is at present engaged, with the assistance of Mr. Calver, in constructing a 37-inch silver-on-glass Newtonian reflector. After some preliminary remarks on the light-collecting powers of reflectors and refractors, he mentioned that sufficient attention had not been given up to the present time to the loss of light which was caused by absorption in passing through the great thickness of glass which was rendered necessary by the curves of a large object-glass. If a 37-inch object-glass were made, the light would have to pass through some eight inches of glass at the centre of the object-glass. For it would be necessary in order to support the weight of the object-glass to make the thickness of the combined lenses nearly as much

at the edge, and even then there would be great difficulties from flexure. He thought that the following ten conditions were necessary for the successful construction of a large instrument:—

1. That there should be no tube, except close to the speculum, and he recommended a square lattice-work frame.
2. The mass of metal between the specula should be as small as possible.
3. The instrument should be equatorially mounted, and capable of being directed to any part of the heavens.
4. That there should be efficient means of supporting the mirror without flexure.
5. That there should be efficient driving apparatus.
6. That there should be a collimator for the ready adjustment of the mirror.
7. That there should be such a mounting as to give the greatest amount of steadiness with the least amount of friction.
8. That there should be efficient means of resilvering the mirror and protecting it from dew.
9. That there should be a safe, steady, and easily-adjusted platform for the observer.
10. That the telescope should be erected in a suitable locality.

Capt. Noble: It seems to me Mr. Common's tenth condition will be the one most difficult to deal with. Everyone who has had much observing experience will know that often when you can use an aperture of 3 inches, one of 7 inches, or a larger instrument, will convert the stars into flickering patches of light, and the larger the aperture the more the difficulty increases. Really, I think the tenth condition resolves itself into the question of how many people can, or are willing to, go and settle themselves at 10,000 to 20,000 feet above the surface of the earth.

The President: The matter Mr. Common has brought before the Society is one of extreme interest, and I should like to make one or two remarks. He has spoken of a 26-inch achromatic as being nearly equal to a reflector of the same aperture, and I should like to ask what are the experiments on which he founds this comparison?

Mr. Common: In this paper I take for granted the data which Dr. Robinson has given—namely, that a 35-inch metal speculum is equal in light-grasping power to a 35-inch object-glass, and that a metal speculum has a reflecting co-efficient of about one-half the silver film.

Mr. Ranyard: Is that taking into account the effect of the reduction of light on the two reflections?

Mr. Common: Yes, with the two reflecting surfaces.

The President: Taking the two surfaces into account would no doubt reduce the light-grasping power of the reflector. Mr. Common referred to the difficulty there is in obtaining glass of large diameter. I can speak with some feeling on that subject, for when my 15-inch telescope was being made, I had considerable difficulty in getting the glass; in fact, we had to return the flint lens three times to the maker before we got a sufficiently good one. Mr. Grubb has taken in hand a 27-inch refractor for the Vienna Observatory, and I understand he has had considerable difficulty with the glass, and if the glass cannot be obtained in the place where it is at present contracted for, he intends to try other makers. There is considerable difficulty in getting a large disc of glass free from striæ in the manufacture. The production of glass for a speculum would not, of course, be so much affected by striæ, but there is the difficulty of annealing the glass when it comes from the cast. I believe Mr. Common can speak with considerable experience on the subject, as he has lost several glasses which have suddenly burst. As to the reflecting power of silver and speculum metal, as far as I remember, the reflective power of the speculum metal is usually given as ·436, and the reflective power of the electro-deposit of silver as ·824; but this does not take into account the tarnished surface, which so soon injures the reflective power of silver. There is a process, an account of which was, I think, published in February or March of last year in the *Chemical News*, for depositing metals by means of an induction spark in a vacuum. I took an interest in the matter at the time, and communicated with Mr. Crookes on the subject. He did not know anything about it; but he tried some experiments, and deposited some platinum and arsenic on glass in a vacuum by making a piece of glass the negative pole from a mass of the solid metal. The film he obtained was of intense hardness, so much so that I thought it might be used for ruled diffraction gratings.

Mr. Common: What size were those specimens?

The President: They were perhaps an inch or half inch; but since that time they have been made larger. I believe the deposition of platinum on glass has become almost a commercial matter, so much so that it is beginning to take the place of bright steel for fireplaces, so as to save trouble to housemaids. As to the question of supporting large discs of glass, Mr. Bessemer some time ago suggested that the back of the mirror should be ground to a curve, and then be laid upon a bed of iron ground as nearly as possible to the same curve. This bed was to be channelled, and have grooves in it; and then by exhausting the air underneath he hoped to obtain a solid foundation for his mirror. But I fancy the plan was never carried out. As to the question of the tube

or lattice in place of the tube, it is some time since I have been to Parsonstown, but I think Lord Rosse prefers having the greater part of his tube merely as lattice, and he has found a decided advantage from placing a cloth, or a shield of black tin, just over the part where the mirror is. It need not be entirely covered up. An equatorial mounting is, of course, the most valuable, and I hope in future no large telescope will ever be mounted without having equatorial motion. Of equal importance is the clockwork and the collimator for finding the position of the mirror. A collimator was made use of by Lord Rosse for his large telescope, I think, at the suggestion of Dr. Robinson. As to the question of stability and want of friction, I do not know what amount of mercury would be required for Mr. Common's plan; but it seems to me that rather a large bulk of mercury would be needed to carry a heavy telescope and relieve the friction as suggested in the paper. As to the question of resilvering, I do not know whether with large discs the silvering could be conveniently done as in the ordinary method, face downwards. If the silvering could be done face upwards, it would be a great advantage. Then with regard to a convenient form of stand, there is nothing more difficult than to get a thoroughly convenient one. In working with a 12 or 14 foot telescope, the best thing to have is a flight of steps, moveable pretty easily.

Mr. Ranyard: I have seen the mounting of Mr. Common's 18-in. telescope, and was exceedingly pleased with the easy action, which I had not expected from the mercurial bath in which the axis is mounted. The bath or case in which this axis nearly floats does not hold so much mercury as might be imagined. It is not necessary to have more than the one-eighth of an inch, or indeed more than a film of mercury, round the axis, and it is very easy to adjust the depth of the mercury, and consequently the pressure upon the toe of the axis can be relieved with great nicety.

Mr. Lecky: The great difficulty with respect to glass specula is in the thickness. When Dr. Draper was here, some years ago, speaking of glass mirrors, he said that his glass was only 2 in. thick. I put a question to him to know whether that really was the case, and he assured the meeting it was. I do not know what his method of support is, but I think it must be difficult to support without flexure a 2-ft. mirror only 2-in. thick. There is great difficulty in getting glass mirrors anything over 4-in. thick. It seems that there is no possibility of annealing glass mirrors from 4 to 6-in. thick. I had occasion to get some large masses of glass some time ago, and I found there was great difficulty in getting a ball 4-in. in diameter. It was almost impossible. No doubt they have been made, and some are being made for the Meteoro-

logical Society; but the difficulties are so great the manufacturers almost refuse to make them. We wrote to Messrs. Chance for their price for a 4-in. ball, and the price they fixed was 25 guineas at that time. Feil's price was less: but the difficulty of annealing is so great. There is, of course, no difficulty in casting such a ball, but with speculum metal there is no difficulty. You can get it of any thickness. That is, if you take certain precautions, of which Mr. Grubb has given a minute account in the *Philosophical Transactions;* but I believe with glass the same thing is impossible, and I know Mr. Grubb seems to think it so.

The President: The glass ball mentioned by Mr. Lecky is not a case in point, because they were required to act as lenses, and they would, consequently, have to be without striæ; but there would be no necessity whatever to have no striæ in a large mirror for a reflector. There is that great advantage in a catoptric over a dioptric instrument.

Mr. Lecky: At the same time I think it is impossible to anneal glass of that thickness so that it would stand without flying,

The President: I know there are difficulties, but they were showing in Paris glass discs for a 4-ft. reflector. I think that I heard that they had only broken one before they got two discs of sufficient thickness. They were, as far as I remember, about 8-in. thick.

Mr. Ranyard: I had an opportunity of seeing Dr. Draper's 28-inch, only I am sorry to say in its unsilvered condition, and I was very pleased with the ingenuity of his method of counteracting the flexure of the mirror. He showed me a high star with it, but I did not notice any signs of flexure. He has a peculiar method of supporting behind with counterpoises, on little levers. Little pieces of glass are cemented on to the mirror behind, and the little levers play upon them. The levers can be shifted and the counterpoise weights adjusted so that the pressure on the back of the mirror can be altered with great nicety.

Mr. Neison: I have had some experience with silvered mirrors under extremely hard conditions. Mr. Common puts particular stress on the necessity of being able to resilver them easily. If you use an instrument in the country I think it probable that it would not require resilvering oftener than once in 10 years. I have had in one of the clearest parts of London (Hampstead) a silvered glass speculum lying in the open air, and it only required rubbing up with leather, and remained in fair working order for five or six years. That is in a place where there is plenty of gas, and where a mirror would easily get tarnished. There are processes of silvering in which too much ammonia is added, and that will cause the film to tarnish in two months; on the other hand, if you get it silvered by a proper method you will have a hard

silver surface which will bear an enormous amount of rubbing, and will keep from tarnishing in an extraordinary manner. I have a 9½-in. mirror that belongs to this Society, which when carefully rubbed up is almost as good as when I came to fetch it away four years ago. With regard to the relative brightness of telescopes—refractors and reflectors—I find the amount of light given by the reflector is generally underestimated. If you have a reflector in good condition, and keep it in good condition, it will come much closer to a refractor than most people fancy. A silvered glass reflector of 8½ in. has proved itself a fair rival of an 8-in. refractor; and in the case of a 15 or 16 in. refractor the amount of light lost from the extra thickness of glass is very enormous. Then, again, with an object glass you can only secure it round the edge, and there must be a tendeney to bend down towards the centre. There has been some proposal to exhaust the air in the tube, and so fix the glass; but there would evidently be great practical difficulties about such an arrangement. But with a reflector there is comparatively no difficulty in supporting them.

The President: I do not know whether Mr. Grubb has made public a new method which he is going to bring out for improving the reflecting power of speculum metal.

Mr. Common: He says that he hopes to save 25 per cent. of the light.

The President: He spoke to me about the plan. I do not think I am at liberty to mention it to the Society.

Mr. Common (in reply) said that if Dr. Robinson's data were correct, a speculum metal reflector of 35 inches aperture was equal in light grasping-power to a refractor of 35 inches aperture. Considering the superior reflecting power of a silver film, the diameter at which there would be equality between the silver-on-glass-reflector and the refractor would be very much less. There was a difficulty in getting discs of optically pure glass of even 15 inches, and Mr. Grubb had found that the difficulty of getting discs for the 27-inch refractor he is making for Vienna did not apply to the reflector, because optical purity is of no account. As to the proportion of light reflected from speculum metal and silver, making every allowance for the 25 per cent. improvement that was to be attained by Mr. Grubb's process, and allowing that chemically deposited silver was not so pure as solid silver, still there would be a large balance in favour of the silver-on-glass-reflector. With regard to supporting the discs, the way I suggest is the same principle that was successful with my 18-in. reflector. As to the Bessemer process, when I say that it is a patented process I think that I have said enough about it. As far as I am aware it has not yet been tried.

On the subject of annealing glass I can speak feelingly, as I have

lost an 18 inch mirror. No glass makers will undertake to make a large glass: it must not be left to them, but must be done by some special means. I received a disc from Paris of 37 or 38 inches in diameter, and 5 inches thick, and we set to work to polish it, and then the difficulty of silvering occurred to me, and I endeavoured to cut a hole through the centre, but in that process it blew up. Then I had another disc made by the French people, who are far more enterprising than the English, and that has already stood hollowing out and curving. As to the need of re-silvering, I am working now with an 18-inch glass mirror, silvered last year; and I have recently seen the four satellites of Uranus at once with it. That, I think, will show that the mirror is still in good working order. All I do to keep the mirror from tarnishing is to have a tin cap fitting tightly over it, and I am not troubled by any symptoms of dew when I take it off. As to the mercury bath Mr. Ranyard has spoken of, there is no difficulty in moving large telescopes with it. The quantity of mercury displaced is equal to about a ton and a half in weight, and therefore gives that amount of lifting power. I allow a thickness of mercury of about 1-16th of an inch, and the quantity used for the 37-inch would cost only between £6 and £7. As to what Mr. Neison has said, the utmost time during which I have used a speculum without resilvering is 16 to 18 months, but that was through ignorance, because I was not then aware of the fact that it could be re-polished with such effect. With proper care, the life of a film of silver ought certainly to be three or four years.

The thanks of the meeting were then voted to Mr. Common for his paper.

Major Tupman said he had observed Brorsen's comet on April 4 and on two or three other nights, about half a degree to the south of its predicted place. It was about two or three minutes in diameter, and could be very easily observed. It appeared about as bright as a 7th magnitude star.

Mr. Plummer: I have observed the comet upon three nights, and one of these was the 4th April. It gives promise of being fairly conspicuous, and has a very well marked condensation, so that it is easily observed. My observations have not been reduced, but I expect they will be more than usually accurate and satisfactory.

Mr. Markwick was called upon to show a diagram which he had constructed from the sun spot MSS. in the possession of the Society. The diagram showed the variation in the spotted condition of the sun in a different manner from that which is ordinarily adopted. Mr. Markwick had drawn a vertical line for every ten separate groups of spots. As in the ordinary sun spot curve

the horizontal line corresponded to the time, 6 inches representing a year. When the spots were large, Mr. Markwick had drawn the vertical lines thicker, and when there were many spots in a given time the vertical lines were, of course, closer together. Thus, at a glance, it could be seen whether the variation in size of spots corresponded with the variation in the number of new spots developed. A curve was also drawn indicating the average number of spots per group for each period of 10 groups.

Mr. Freeman: If I rightly understand, Mr. Markwick has made an attempt to represent the area of the spots. The question of area seems to me most important. The frequency is in comparison of little consequence; but the total magnitude of the spots in groups is of great consequence in estimating the amount of solar atmospheric disturbance.

Mr. Markwick said he had not laid down a curve showing the areas, but he had tried to represent the average diameter of the largest spot in each group by the thickness of the vertical lines.

Mr. Ranyard: It seems to me that the advantage of Mr. Markwick's method is that he is able to show at one glance the variation in the number of spots and in the size of the spots, and also the way in which groups were broken up. The area of the spots can, of course, be measured, as at Kew, by the superposition of glass divided into small squares on the spots, and counting the number of squares within the nucleus. It might also be an advantage to give the penumbral area, which is, no doubt, different, according as the spots are complicated or not. Whether the periods of maximum sun spot development correspond with the periods of maximum penumbral area and maximum area of nucleus, I do not know.

Mr. Common read a paper *On the desirability of photographing Saturn and Mars at the next conjunction on June the 30th, 1879, so as to show the relative intensity of the light of the two planets.* By using the wet-plate process and then dry plates, which are more sensitive to the red rays, the different effect of the light of the planets might be made apparent. He showed some photographs of Jupiter and Saturn in explanation of these views.

Mr. Ranyard said the photographs give good evidence of the sharp definition of Mr. Common's 18-inch reflector. Possibly these photographs may have considerable physical interest at some future time. With regard to the planet Jupiter, there seems to be evidence that the colour of the equatorial region changes. Whether the colour varies with the sun spot period, I am not prepared to say; but I certainly think that there is sufficient evidence that the equatorial region of Jupiter is at some times redder than at other times; and if photographs are taken at different periods, the actinic power of the light of the equatorial

regions might be roughly compared; and so another method of detecting change of colour, more certain than eye estimates, would be at the disposal of observers.

Mr. Common (in reply to Mr. Brett) said the plates he used were the dry plates of Mawson and Swan.

Mr. Brett: Are they quicker for this purpose than the wet plates?

Mr. Common: Certainly.

The President: I think they are painfully quicker than the wet plates. At the transit of Mercury I found Mawson and Swan's plates too quick for anything.

Mr. Ranyard: For very intense light no doubt they are quicker.

Mr. Common said that with wet plates, which were not so sensitive to the red rays, he obtained photographs of Jupiter on which the northern and southern hemispheres appeared to be absolutely separated. The equatorial belts did not produce much effect upon the collodion, but with the dry plates this was not the case.

Mr. Ranyard: Yes, I have also noticed that difference.

Mr. Common went on to say, if astronomers would photograph Saturn and Mars in the same way, they would learn something about their colour, and some result might, perhaps, be obtained from it. He had no doubt the red rays acted vigorously upon the dry plates, producing a denser film, whereas upon the plain iodized collodion they produced no effect at all.

The President said he referred to one of the first photographs he had taken as long ago as August or September, 1870. It was taken by the wet process under Mr. De La Rue's instructions at his observatory at Cranbrook. In it the planet Jupiter seemed to be divided into two segments. The belts absolutely made no impression on the collodion.

Mr. Common thought the changes in the photograph indicated a decided change in the planet. If photographs were taken at various times they would know more about such changes.

Mr. Ranyard: The difficulty is to get a constant source of light to photograph at the same time with the planets.

The following papers were also laid on the table and taken as read:—

A. Marth: *Ephemeris for physical observations of Jupiter*, 1879.

Dr. A. de Gasparis: *On some formulæ for expressing the value of the eccentric anomaly, etc., in functions of the mean anomaly.*

The meeting adjourned at a quarter to ten.

METEORIC DUST.

From the *Times* of April 12, 1879.

Mr. A. C. Ranyard, secretary of the Astronomical Society, has recently called attention to the evidence which our earth's surface affords of her passage through meteoric systems. Meteoric dust has been collected on the summits of snow-covered mountains. In the snows of Scandinavia and Finland, or those lying far within the Arctic circle, hundreds of miles from any human habitation, particles of meteoric iron have been found. Iron dust has been gathered in ice-holes in Greenland. Nay, in matter raised from the bottom of deep oceans magnetic particles have been detected, which must have been deposited there recently, and can no otherwise have come there save from the air above those oceans, nor have reached that air except from interplanetary space. It is true that all this might have been confidently foreseen. We know in other ways that meteoric matter is constantly falling upon the earth. Yet there is a strange interest in the actual recognition of this cosmical dust. What Humboldt said of the larger meteoric masses which have fallen visibly upon the earth from interplanetary space is true (with slight change) of these more subtle signs of the earth's passage through cosmical dust:—"Accustomed to know non-telluric bodies solely by measurement, by calculation, and by the inferences of our reason, it is with a sense of wonder that we touch, weigh, and submit to chemical analysis metallic and earthly masses appertaining to the world without."

We had occasion, in discussing the shooting stars of November 25-27 (the later November system, as it may be called), to consider the history of recent research into meteoric and cometic systems, already one of the most fruitful subjects of astronomical inquiry, and likely, unless we mistake, to lead to yet more important inferences and conclusions than have yet been even suggested. Mr. Ranyard's speculations—for as yet we fear they can hardly be called theories—invite to a consideration of the results of those inquiries, the history of which we have already given. Until it had been shown that meteors and comets are associated (in some way as yet not clearly understood), the only evidence we could obtain about meteoric systems was by the earth's actual encounter with them. As she circles year by year round her wide orbit, 185 million miles in diameter, her small globe (for in this relation it is almost infinitely minute) encounters such meteors as may happen to be crossing any point of her track at the moment of her arrival there. Multitudes of cosmical bodies may cross that track without her encountering them; and, moreover, for every meteor track which crosses the earth's there must

be millions which do not. Thus even of meteor-systems which the earth can, on occasion, encounter, we may remain for ages ignorant, while of those which the earth never can encounter we must for ever remain ignorant, unless we can learn something of them in another way. The astronomer may detect the comet along whose track one of those meteor-systems, "fathomless by man," pursues its course around the sun. Then, though we may never know certainly the nature of that system, we may be able to infer its existence and perhaps form some more or less probable surmise respecting its importance. And from the general evidence collected by astronomers about comets and comet-systems, with such theories as they may hereafter be able to establish respecting the meteoric and cometic nature of certain solar appendages, we may learn the laws according to which the meteor families attending on the sun are distributed. But it is clear that our knowledge respecting meteors must for a long while be derived chiefly from the study of those meteors which actually reach the earth either as aërolites, as fire-balls, or as shooting stars. In other words, our more intimate knowledge of meteors must be limited to those few meteoric systems which cross the ring of space traversed by the earth in her annual motion around the sun. How exceedingly minute the number of systems thus encountered must be when compared with the total number (even supposing the distribution uniform, instead of being, as it probably is, far denser near the sun than at the earth's distance) can be inferred from the consideration that if the earth's track—that is, the ring of space swept by her whole body and its atmospheric envelope—were represented by a circle of wire a yard in diameter, the thickness of the wire would be less than 1-600th part of an inch. Remembering this and also that it is not the whole even of this relatively fine ring in space which is occupied by observers of meteors at any given instant, but only the minute portion of it which the earth at that instant occupies; that the meteors which fall on the sunlit half of the earth are never seen, unless now and then an exceptionally large mass forces its way through the earth's atmospheric envelope; that on the dark or night half of the earth few are on the look out for meteors—we perceive that our knowledge of the meteoric systems in the solar domain must long remain exceedingly imperfect, nay, by comparison with the real vastness of the subject, must be all but evanescent.

But the same considerations which might well make astronomers despair of mastering this difficult subject enhance our wonder at the facts actually ascertained respecting meteor systems encountered by the earth. Already we have evidence that in her circuit round the sun she encounters more than 200 meteor systems, or, more strictly, that she passes through the orbits of so

many systems. Again, from calculations based on the average number of shooting stars observed per hour at single stations, Professor Newton, of Yale College, United States, has estimated that in a single year the earth encounters as many as 400 millions of meteors, from the largest aërolite down to the smallest body which could be seen in a good telescope as a shooting star, if by chance it passed athwart the telescopic field of view. Without laying stress on the numbers, we may say that, roughly, about a million meteors are gathered up by the earth every day, more than 40,000 per hour, and (on the average, it will be understood) some 10 or 12 per second. As almost all of these bodies enter the earth's atmosphere with velocities compared with which that of a rifle-bullet is as rest, it follows that, however minute the majority of these meteoric visitants may be, the very least of them striking man or animal in any vital spot would cause death. But fortunately we are protected from all risk of this sort by a very efficient shield—the soft and yielding air, the resistance of which turns all save the largest meteors into vapour before they have penetrated even its outermost layers. The condensation of the metallic vapours into the finest possible metallic dust, and the eventual subsidence of this dust upon the earth's surface explain, doubtless, the detection of metallic particles in regions far remote from human habitation—or rather, we might have been certain, even had no meteoric particles been detected by Reichenbach, Phipson, Nordensjöld, and the rest, that they must exist in Arctic snows and glacial crevices, on mountain summits and at the sea bottom.

Whether, however, we can safely pass from the sure ground of these known facts to the inferences which have been recently suggested, we may be permitted to doubt. Mr. Ranyard, for instance, submits that the facts go to show that meteoric matter falling in the lapse of ages must materially contribute to the matter of the earth's crust. He goes further. Not only does the total meteoric downfall, in his opinion, add appreciably to the matter of the earth's crust, but the excess of the downfall on the northern hemisphere of the earth may, he considers, account for the preponderating mass of the continents in the northern hemisphere of the earth, and for the fact that nearly all the peninsulas taper towards the south. This excess of northern meteoric downfall must of necessity bear a very small proportion to the total downfall. For it is certain that nearly all the meteoric families travel in closed orbits around the sun. It has, indeed, never been proved that any now come from instellar space, though probably some do. Of those that do visit our solar systems from without, rather more would salute the northern than the southern hemisphere of the earth, simply because the solar system pursues a somewhat

northerly course in its journey through instellar space. But, manifestly, if a small proportion only of our meteoric visitants come from outside the solar domain, and among such visitors those from the north exceed those from the south in a certain degree only, the actual excess of meteoric downfall on the earth's northern hemisphere over that on the southern must be very slight compared with the total meteoric downfall. But even the total downfall would not, at its present rate, or even at the present rate increased a thousandfold, cause the earth's crust to grow appreciably in the lapse of ages—understanding by ages thousands of years. It has been shown by Professor Alexander Herschel that the average weight of shooting stars, visible to the eye, must be estimated rather by grains than by ounces; and the telescopic shooting stars, which form nine-tenths of the total, according to Professor Newton's estimate, are, of course, far smaller. But assigning even to each meteor a weight of 1lb.—an utterly inadmissible estimate—let us consider at what rate the earth's crust would grow. The earth has a surface of 200 million square miles, and about 400 million meteors fall upon it per annum. That gives two meteors, or 2lb. weight of matter, added to each square mile in a year. There are more than three million square yards in a square mile, so that 1,500,000 years would be required at the present rate of meteoric downfall to add 1lb. of meteoric matter to each square yard of the earth's surface. Such added matter, uniformly spread over the surface, would be utterly inappreciable, so far as the thickness of the earth's crust is concerned. In a thousand millions of years at that rate, which far exceeds the real rate, the crust of the earth would not be increased in thickness by a single foot. The excess of increase in the northern hemisphere would not be one foot in a billion of years. We must, assuredly, look to some other cause for the preponderating mass of the continents in the northern hemisphere.

So, also, of the suggested addition of large quantities of gas to our atmosphere. Doubtless some meteors carry many times their own volume of occluded gas, and as they are vaporized during their rush through the air this gas is given off. Very important effects may result from this process, since relatively minute additions of gaseous matter to our atmosphere may sensibly affect creatures which depend on that atmosphere for their existence. But that atmospheric pressure can be sensibly modified from day to day, or in longer intervals, by the addition of gases occluded in meteors, the entire annual supply of which, if wholly gaseous and if all added in a single instant, would not increase the height of the barometer by a hair's breadth, is a proposition physically inadmissible. We need not care, however, to consider doubtful details such as these, where the general

relations involved and the conclusions which admit of being demonstrated are so important and so interesting as those involved in the recent discoveries of meteoric astronomy or deducible from them.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.
To all communications must be annexed the name and address of the sender, as a guarantee of good faith.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

OXYGEN IN THE SUN.

Dear Sir,—I enclose a copy of a letter from Dr. Henry Draper which, though written to me privately, I think you will consider of sufficient public interest to print in the *Register*. The importance of Dr. Draper's discovery has not yet, I think, been realized in this country, and I am anxious that there should be a good meeting in June to welcome him.

Yours faithfully,
A. C. RANYARD.

(Copy.)

To A. Cowper Ranyard, Esq.

My dear Sir,—Since I last wrote to you I have had surprising success with the "oxygen in the sun" work, so much so that I am in hopes of being able to come to England for a few days in June to confront the objectors. My intention in writing now is to ask you whether I could have the opportunity of being present at the June meeting of the Astronomical Society, to show the results I have obtained, and make a few explanatory remarks in relation to the method of producing the photographs. If I could have fifteen or twenty minutes of the Society's time it would probably decide me to make the journey across the Atlantic. . . .

My original negatives are now on a scale about half the size of Angstrom's chart, and they readily bear enlarging four times.

271, Madison Avenue, Yours very truly,
New York: April 4, 1879. (Signed) HENRY DRAPER.

THE RED SPOTS ON JUPITER.

Sir,—The following remarks, which I translate from a letter of M. Niesten, of the Brussels Observatory, cannot fail to interest your readers.

Ashdown Cottage, Forest Row, I remain, &c.,
Sussex: April 19, 1879. H. J. SLACK.

M. Niesten says—"I read with lively interest the note which M. Trouvelot published in the *Observatory* on April 1, 1879, on certain spots which appeared on the disk of Jupiter during the last opposition, and beg to add some remarks founded upon my own observation of this planet. From July 16 to the end of October I made a series of sketches each time the state of the sky permitted, and on consulting them after reading the interesting article of M. Trouvelot I found that the spot observed by Mr. Pritchett on the 9th of July was shown in my sketches of 6th August, 10h. 45m., 8th August, 12h. 40m., and 2nd Sept. 8h. 30m. What follows I extract from my notes.

"Aug. 6, 10h. 45m. Brussels mean time. Above the south equatorial belt, in the S.E., and E. of centre, a *reddish spot.*

"Aug. 8, 12h. 40m. South temperate belt point; between it and the south equatorial band a *red spot.*

"Sept. 2, 8h. 30m. Above the south equatorial belt, from the middle towards the S.E., a rosy cloud (*nuage rosé*), bordered on the east and west with white. This spot was very plain, and especially on Sept. 2, contrasted with the white background on which it was projected. Its tint was of a much more decided red than the north equatorial belts, which I have nearly always noticed of a dull brick colour. According to my drawings its position was somewhat oblique in relation to the belts, and not parallel, as in M. Trouvelot's drawing. This spot, having a strong resemblance to that observed by M. Trouvelot, led me to ascertain, with the aid of the ephemerides of M. Marth, what meridians presented themselves in the centre of the disk at the date of my observations. I found them to be about 186°, 190°, 204°, occupying the central positions on Aug. 6, 10h. 45m, Aug. 8, 12h. 40m., and Sept. 2, 8h. 30m. respectively. Also, when M. Trouvelot sketched the spot, on Sept. 25, 6h. 30m. Greenwich mean time, the meridian was 172°, and when Mr. Pritchett observed, on July 9, it was 174°. These two observers drew the spot when it was at the centre of the disk, while in my drawings it had not yet reached that point. On Sept. 2, however, it was near the central meridian. The spot which Mr. Pritchett drew on the 9th, that M. Trouvelot observed on many occasions, and that which I saw three times, occupied apparently (*sensiblement*) the same position, and I am, therefore, led to suppose them identical. I do not, therefore, agree with M. Trouvelot when he says—"However, it was certainly not the same identical spot seen by Professor Pritchett, since he was unable to see it again on July 10 and 15, when it should have been visible if it still existed."

"As I have said before, the spot observed on July 9 by Mr. Pritchett had nearly the same longitude as that which M. Trouvelot drew on Sept. 25. Moreover, Mr. Pritchett evidently did not see

the red cloud on July 10, nor on the 15th of that month, while at the time of these observations meridians 287 and 324 presented themselves to the observer in the centre of the disk, as Mr. Dennett remarked in his letter to the *Observatory* on January 13. In my opinion the result of the different observations is to show that this reddish spot exhibited a character of permanence, being observed for the first time on July 9 by Mr. Pritchett, sketched by me in August and September, and still found by M. Trouvelot at the end of December. It is very curious that a similar spot should have been seen under another meridian, as is well known from the observations of Lord Rosse during the opposition of 1872-3. In fact, in the drawings published in the *Monthly Notices* we see a reddish spot in the south temperate zone. Lord Rosse wrote concerning it: 'Sketch No. 2, March 7th, 11h. 33m. G. M. T. Central meridian 259·9 *a* and *b* are very white, the following part of *b* is reddish. No. 3, April 10th, 9h. 12m. Central meridian 256·1; *b* is very white, with a reddish patch on the following side. No. 4, March 22nd, 10h. 21m. Central meridian 316. There is a reddish spot on the preceding side of *a* and *b*. No. 18, Feb. 8, 13h. 30m. Central meridian 220·6. A reddish yellow patch on the following side of *b*.

A MATTER OF WORDS.

SIR,—In astronomical books we now and then meet with such expressions as "Jupiter's Moons," "our satellite," and the earth spoken of as the "primary" of the Moon. I cannot but think all these expressions are objectionable. The same word ought not to be applied to the moon and to the small bodies which go round the superior planets. Those small bodies are so controlled by gravitation towards their respective planets that they would follow the planets if they left their orbit round the sun, and are rightly called "satellites," a word which signifies attendants, or dependents, and the planets are rightly called "primaries."

The moon, however, is altogether differently circumstanced, for were the earth to leave its orbit, going away from the moon, the latter would not follow, but would continue a course round the sun. It consequently seems incorrect to call it the "satellite" of the earth, or to speak of the earth as its "primary."

The true conditions of the earth and moon would, I think, be best expressed by speaking of them as a "binary planet," or with Admiral Smyth a "twofold planet."

Your obedient servant,

T. W.

METEORIC DUST.

Sir,—The writer of an able article on "Meteoric Dust," published in the *Times* of Saturday, the 12th inst., referring to a paper of mine published in the *Monthly Notices* of the Royal Astronomical Society, attempts to fix a limit to the amount of meteoric matter which would probably be received on the earth's surface in the course of a thousand millions of years. For this purpose he makes use of data collected by an American observer with regard to the fall of meteoric particles, which are sufficiently large to make themselves visible either to the naked eye or in the telescope as shooting stars; but the meteoric dust, which was the subject of my paper, is left out of consideration.

There are many facts which seem to point to the existence of great quantities of meteoric dust distributed in space. The polarized condition of the light derived from the tails of comets and from the corona, shows that the greater part of the light received from these sources has been dispersed by particles which are small compared with the wave length of light. Without stopping here to inquire whether any portion of the matter of the corona is driven outward into space, we may be certain that the matter driven backward from every comet and flight of stones which approaches the sun and other stars, is not lost, but pursues its course until it comes into the neighbourhood of another system.

The beautiful experiments of Mr. Crookes show that when a solid body approaches a source of heat, particles are thrown off in the direction in which the heat is received, and the heated body, if small, is driven backward with considerable velocity. This process is, no doubt, continually going on in the case of every meteorite which approaches the sun. It is only when the flight of stones is large that a part of the matter evaporated towards the sun, and the precipitated particles driven backward into space, are sufficiently conspicuous to be seen as a comet.

But besides the impalpable dust which is thus continually being driven into space, and the smaller particles thrown off in the contrary direction, there is probably a still coarser meteoric dust, for we know that the meteoric masses which make themselves visible as they enter the earth's atmosphere are of all sizes. The meteors which are consumed in the upper atmosphere are very numerous compared with those which are of sufficient diameter to reach the earth's surface, and the number of small telescopic meteors bears a very large proportion to the number of naked eye meteors and fireballs, and it seems probable that there are still greater numbers of meteoric particles, which, by reason of their small mass as compared with the surface they offer for

resistance, are stopped in the higher regions of the atmosphere, without evolving sufficient light to make themselves visible to observers at a distance of 70 or 80 miles below them.

The writer of the article in the *Times* states that "nearly all the meteoric families travel in closed orbits around the sun;" but it should be remembered that, besides the meteors whose apparent paths pass through radiant points corresponding to known closed orbits, there are great numbers of sporadic meteors, and there is much evidence laboriously collected by Professor G. von Niessl, Prof. Alex. Herschel, and others, that goes to show that many of the larger meteors enter the earth's atmosphere with velocities indicating that they are moving in hyperbolic orbits, and consequently that they come from outer space. Corresponding observations of the smaller sporadic meteors have not so frequently been made, and we consequently have less evidence with regard to their velocities which would enable us to judge as to whether they belong to the solar system or not.

As to the relative amount of cosmic matter falling in the northern and southern hemispheres of the earth, it should be remembered that the northern pole of the earth's axis is now at nearly its greatest distance from the apex of the sun's way. In 13,000 years the pole of the earth will be about 45° nearer to the direction in which the solar system is travelling than it is at the present time.

It may be urged that great quantities of dust distributed in space would tend to obliterate the light of the stars, and I would answer that we have no evidence that it does not do so. Dark spaces, like the coal-sacks of the Milky-way, and the dark channels and markings on some of the larger nebulæ, seem to me to point to the existence of light-absorbing clouds between us and an illuminated background, rather than to a complicated configuration of the luminous masses. And it is possible that the solar system in its motion through space occasionally passes through such regions richer in meteoric dust than surrounding space.

Your obedient servant,

A. C. RANYARD.

[Mr. Ranyard has forwarded us for publication the above letter, in answer to the objections to his theory raised in the article which we have reprinted elsewhere. Mr. Ranyard's letter was, we understand, sent in the first instance to the *Times*, but was not inserted. We have great pleasure in giving Mr. Ranyard an opportunity of expressing his views upon the matter.—EDITOR.]

ASTRONOMICAL OCCURRENCES FOR MAY, 1879.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Thur	1		Sidereal Time at Mean Noon 2h. 36m. 10·238.	3rd Sh. E.	15 25	Arcturus — 11 32·1
Fri	2		Sun's Meridian Passage 3m. 6·19s. before Mean Noon	2nd Oc. R. 4th Sh. E.	15 20 16 28	11 28·2
Sat	3	9 19 9 56	Occultation of q Virginis (6) Reappearance of ditto			11 24·2
Sun	4			1st Sh. I.	15 15	11 20·3
Mon	5	18 11	○ Full Moon	1st Oc. R.	15 58	11 16·4
Tues	6					11 12·4
Wed	7					11 8·5
Thur	8			3rd Sh. I.	15 43	11 4·6
Fri	9	14 31 15 42 3	Occultation of B.A.C. 6490 (6½) Reappearance of ditto Conjunction of Jupiter and Mars 0° 53′ S.			11 0·6
Sat	10					10 56·7
Sun	11					10 52·8
Mon	12	14 35	☾ Moon's Last Quarter	1st Ec. D. 3rd Oc. R.	14 18 33 14 31	10 48·8
Tues	13			1st Tr. E.	15 16	10 44·9
Wed	14	3 10	Conjunction of Moon and Jupiter 4° 49′ S. Conjunction of Moon and Mars 6° 0′ S.			10 40·9
Thur	15		Illuminated portion of disc of Venus=0·758 Illuminated portion of disc of Mars=0·864			10 37·0
Fri	16	23	Conjunction of Moon and Saturn 7° 48′ S.	2nd Ec. D	15 9 58	10 33·1

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sat	17		Sidereal Time at Mean Noon 3h. 39m. 15·19s.			Arcturus 10 29·2
Sun	18	17	Conjunction of Moon and Mercury 8° 47′ S.	2nd Tr. E.	14 52	10 25·2
Mon	19		Sun's Meridian Passage 3m. 45·38s. before Mean Noon	3rd Oc. D.	15 3	10 21·3
Tues	20	17 50 15	● New Moon Conjunction of Venus and ε Capricorni 0° 5′ S. Saturn's Ring : Major axis=37″·04 Minor axis= 5″·87	1st Tr. I. 1st Sh. E.	14 52 15 51	10 17·4
Wed	21	4	Uranus at quadrature with the Sun	1st Oc. R.	14 20	10 13·4
Thur	22					10 9·5
Fri	23					10 5·6
Sat	24	8 53 6	Near approach of 44 Geminorum (6½) Conjunction of Moon and Venus 1° 1′ N.			10 1·6
Sun	25			2nd Tr. I. 2nd Sh. E.	14 38 14 48	9 57·7
Mon	26	9 26 10 2 12 16	Occultation of 54 Cancri (6½) Reappearance of ditto Near approach of *o*¹ Cancri (6)	3rd Ec. D.	13 37 56	6 53·8
Tues	27			4th Ec. D. 1st Sh. I.	13 29 33 15 25	9 49·8
Wed	28	11 36	☽ Moon's First Quarter			9 45·9
Thur	29			1st Tr. E.	13 35	9 41·9
Fri	30					9 38·0
Sat	31					9 34·1
JUNE *Sun*	1	18	Jupiter at quadrature with the Sun	2nd Sh. I.	14 29	9 30·2

THE PLANETS FOR MAY.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury...	1st	1 20 40	N. 6 17	10″·4	22 40·8
	9th	1 34 42	N. 6 32½	9″·0	22 23·3
	17th	2 2 38	N. 8 59	7″·6	22 19·7
	25th	2 42 11	N.12 52½	6″·6	22 27·7
Venus ...	1st	4 55 33	N.24 10	13″·2	2 19·0
	9th	5 36 57	N.25 10½	13″·8	2 28·8
	17th	6 18 24	N.25 27	14″·4	2 38·7
	25th	6 59 18	N.24 59	15″·2	2 48·0
Mars ...	1st	22 21 11	S. 12 1½	7″·8	19 41·8
	9th	22 43 31	S. 9 59	8″·1	19 32·6
	17th	23 5 30	S. 7 52	8″·4	19 23·1
	25th	23 7 8	S. 5 42½	8″·7	19 13·2
Jupiter ...	1st	22 37 18	S. 9 41	34″·4	19 57·8
	9th	22 42 2	S. 9 14½	35″·2	19 31·1
	17th	22 46 15	S. 8 51½	36″·0	19 3·8
	25th	22 49 53	S. 8 31½	36″·8	18 36·1
Uranus ...	1st	10 9 52	N.12 10	4″·2	7 32·5
	17th	10 9 57	N.12 9	4″·0	6 29·6

Mercury is not favourably situated for observation on the 1st, rising about half an hour before the sun, the interval slightly increasing.

Venus sets about three hours and a half after the sun at the beginning of the month, the interval varying little throughout the month.

Mars rises nearly two hours before the sun, the interval increasing.

Jupiter rises an hour and three-quarters before the sun on the 1st, the interval increasing. On the 31st he rises an hour after midnight.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN MAY, 1879.

BY W. R. BIRT, F.R.A.S., P.S.S.

REGION NEAR HYGINUS. A recent observer of this lunar district, Mr. W. Goodacre, of Finsbury Park, has called attention to the dark spot south-west of Hyginus (1 A η 7 or π of Capt. Noble's key plan of the region inserted in 716 of the *English Mechanic*, Dec. 13, 1878, p. 335) which he was observing on the evening of April 4, at 10.30 p.m. He says (*English Mechanic*, No. 734, April 18, 1879, p. 135, letter 15,546), "on the dark spot A of my sketch two or three bright spots were very easily discovered, appearing very much like minute craters." As this spot has been under observation for several years, and up to the present time no changes that the writer is aware of have been recorded in its appearance, certainly not of the kind mentioned by Mr. Goodacre, it is of importance that it should be examined by large telescopes, first as confirming or otherwise Mr. Goodacre's observations, and second to determine accurately the position of the *two or three* (which?) bright spots on the surface of the dark spot.

Water Lane, Stratford, E.:
April 18, 1879.

VARIABLE STARS, MAY.

Approximate times of minima and maxima, according to Schönfeld and Winnecke.

1879.	G.M.T. h.			mag.	R.A. h.	m.	s.	1855. Decl. °	′
May 1		S Ursæ maj.	min.	11	12	37	35	+ 61	53·3
2		S Sagittarii	max.	10	19	10	57	— 19	17·8
5	12·6	δ Libræ	min.	6	14	53	14	— 7	56·1
6		S Aquilæ	min.	11	20	4	57	+ 15	11·5
—		R Camelopardi	max.	7	14	28	54	+ 84	29·2
9		χ Cygni	max.	5	19	45	0	+ 32	33·0
10		R Vulpeculæ	min.	9·5	19	42	27	+ 26	55·7
11		U Virginis	max.	7·5	13	20	19	— 2	25·2
12	12·2	δ Libræ	min.	6					
19	11·8	δ Libræ	min.	6					
20		S Delphini	min.	11	20	36	24	+ 16	34·2
—		R Canis min.	max.	7·5	7	0	44	+ 10	14·9
22	14·6	U Coronæ	min.	9	15	12	17	+ 32	10·8
25		S Cephei	min.	11·5	21	36	57	+ 77	58·2
26	11·3	δ Libræ	min.	6					
27		S Herculis	max.	6·5	16	45	18	+ 15	11·4
28		U Capricorni	max.	10	20	40	4	— 15	18·8
29	12·2	U Coronæ	min.	9	15	12	17	+ 32	10·8
—		T Capricorni	max.	9	21	14	0	— 15	46·4
June 1		S Virginis	min.		13	25	26	— 6	26·8

SATELLITES OF URANUS.

Major and minor semi-axes a and b of the apparent ellipses described by the satellites, and position-angles p_o of the major axes:

	Ariel.		Umbriel.		Titania.		Oberon.		
1879.	a	b	a	b	a	b	a	b	p_o
	″	″	″	″	″	″	″	″	°
May 5	14·68	3·93	20·45	5·48	33·55	8·99	44·86	12·02	12·30
15	14·55	3·89	20·27	5·42	33·24	8 89	44·46	11·89	12·31
25	14·42	3·83	20·08	5·34	32·94	8·75	44·05	11·70	12·34

In these apparent orbits the satellites move in the direction of decreasing position-angles, from their greatest northern elongation N. (in position angle 12°·3) to inferior conjunction (pos. 282°·3), greatest southern elongation S. (pos. 192°·3), superior conjunction (pos. 102°·3), etc. The satellites will be at these points of their orbits about the following hours, G.M.T.:

Ariel. 1879.	h.		Umbriel.	h.		Titania.	h.		Oberon.	h.	
May 1	18	S.	May 2	2	S.	May 1	14	N.	May 3	19	inf.
3	1	N.	4	4	N.	3	18	inf.	7	3	S.
4	7	S.	6	6	S.	5	22	S.	10	12	sup.
5	13	N.	8	8	N.	8	2	sup.	13	21	N.
6	19	S.	10	9	S.	10	6	N.	17	6	inf.
8	2	N.	12	11	N.	12	11	inf.	20	15	S.
9	8	S.	14	13	S.	14	15	S.	23	23	sup.
10	14	N.	16	14	N.	16	19	sup.	27	8	N.
11	20	S.	18	16	S.	18	23	N.	Ariel.		
13	3	N.	20	18	N.	21	4	inf.	19	10	S.
14	9	S.	22	20	S.	23	8	S.	20	16	N.
15	15	N.	24	21	N.	25	12	sup.	21	22	S.
16	21	S.							23	5	N.
18	4	N.							24	11	S.

JUPITER.

1879. oh. Gr.	Angle of position of 4's axis.	Latitude of Earth above 4's equator.	Latitude of Sun above 4's equator.	Equat. diameter.	Greatest phase.
	°	°	°	″	′
May 20	335·63	+1·12	+0·71	38·30	0·38
30	335·49	+1·20	+0·75	39·50	0·41

The assumed First Meridian passes the middle of the illuminated disk at the following times:

1879.	G. M. T.					
	h. m.		h. m.		h. m.	
May 20	15 49·1	May 25	4 59·3	May 29	8 14·0	
21	1 44·6		14 54·8		18 9·5	
	11 40·0	26	0 50·3	30	4 5·0	
	21 35·5		10 45·8		14 0·4	
22	7 31·0		20 41·2		23 55·9	
	17 26·5	27	6 36·7	31	9 51·4	
23	3 22·0		16 32·3		19 46·8	
	13 17·4	28	2 27·6	June 1	5 42·3	
	23 12.9		12 23·1		15 37·7	
24	9 8·4		22 18·6	2	1 33·2	
	19 3·8				11 28·7	
						A. M.

Books received.—Recherches sur les couleurs des étoiles double. Par M. L. Niesten.—Observations sur l'aspect physique de la planète Mars. Par M. L. Niesten. Bruxelles. 1878.—Greenwich Nine Year Catalogue of 2263 stars for 1872.—Greenwich Astronomical Results, 1878.—New Views in Astronomy. By John Harris. 1879.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec., 1878.
Metford, W. E.
Yeates & Son, Messrs.
Yeates, Miss

To March, 1879.
Barneby, T.
Campbell, Colonel
Potter, Rev. T. J.
Potter, T.

To June, 1879.
Lewis, H. K.

To July, 1879.
Denning, W. F.

To Sept, 1879.
Bruce, Rev. W. C.

To Dec., 1879.
Garnett, W.
Gould, Rev. R. T.
Prince, C. L.
Rivaz, Miss

To March, 1880.
Jackson, Rev. W.
Matthews, Rev. W.

To Dec., 1880.
Lawrence, E.

TO CORRESPONDENTS.

We cannot publish communications which are not authenticated by the name and address of the sender, as a guarantee of good faith.

When subscriptions sent by post are not acknowledged in the next number, the Editor will be much obliged if subscribers will *at once* inform him of the fact.

All Letters requiring an answer must enclose a penny stamp.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or *penny* postage stamps, but the Editor will not be liable for loss in transmission.

Post Office Orders for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register.

No. 198. JUNE. 1879.

ROYAL ASTRONOMICAL SOCIETY.

Session 1879—80.

Third Meeting of the Session, May 9th, 1879.

Lord Lindsay, M.P., F.R.S., &c., *President*, in the Chair.

Secretaries—Mr. Glaisher and Mr. Ranyard.

The minutes of the preceding meeting were read and confirmed.

Captain Edward Barnes, of the Lawn, Belper.
The Rev. William C. Bruce, M.A., of St. Nicholas Rectory, Glamorganshire.
George Thorn Gwilliam, Esq., of 35, Lansdowne Crescent, W.
John Penn Hartree, Esq., M.A., of Strandtown, Belfast.
Charles Augustus Jenkins, Esq., of the University Observatory, Oxford, and
William Edward Plummer, Esq., of the University Observatory, Oxford,

were balloted for and duly elected Fellows of the Society.

Mr. Glaisher said that 52 presents had been received since the last meeting of the Society; amongst them was a long series of volumes of the *Nautical Almanac*, from 1798 to 1853, which had been presented to the Society by a grandson of Mr. Thomas Wright Hill, an old Fellow of the Society. There was already a complete set in the Library, but these would form a duplicate set

for lending out of the Library. The Society was indebted to Mr. De La Rue for having procured the gift for them.

The President: I will also mention a present from M. Wolf, who has sent to the Society a monograph which he has written upon the Pleiades, with a chart of 600 stars of the cluster whose position he has observed.

The President: Before proceeding to the ordinary business of the Society, I think it may conduce to the well-being of the Society if I read to the Fellows a resolution which has been passed by the Council; it was taken into consideration at the last meeting and only finished to-day. It runs thus:—

"Since the publication of the *Monthly Notices* for January, 1879, the attention of the Council has been recalled to an article headed *Notes on the late Admiral Smyth's Cycle of Celestial Objects, &c.*, by Herbert Sadler, Esq., containing remarks on several of the star measures given in that catalogue, and also containing a sentence reflecting on the 'Reference catalogue of multiple and double stars,' forming Vol. XL. of the *Memoirs*.

"The Council, feeling themselves responsible for the contents of the Society's publications, cannot but express their regret that they should have authorized the printing of this article in its present form. While they desire to uphold to the utmost perfect freedom in the criticism of scientific works, they would at the same time enforce a general rule to exclude from the Society's publications any imputation on the personal honour or good faith of the authors; and they are sorry to observe in Mr. Sadler's article some remarks which are capable of being, and to the knowledge of the Council have been, construed in a sense which infringes this rule.

"The Council are, moreover, of opinion that Mr. Sadler was not justified in passing a sweeping condemnation of the Reference Catalogue, which is irrelevant to the rest of the article, and is entirely unsupported by the citation of the instances on which his judgment was founded."

It was resolved at the Council to-day that these resolutions were to be printed in the next number of the *Monthly Notices*, and were to be read at this meeting of the Society. (Hear, hear.)

The Council have also at their meeting to-day received notice of the following resolution from Mr. Chambers, but it was decided that leave could not be given to put it at this evening's meeting. The proposed resolution runs thus:—

"That accusations of wilful fraud in connection with the composition by the late Admiral Smyth, of his *Cycle of Celestial Objects*, having been made by Mr. Herbert Sadler, a member of the Council, this meeting is of opinion that the Council are

deserving of censure for not having taken steps to have those charges either proved or retracted, and calls for the immediate resignation of Mr. Sadler."

Mr. Chambers: It was not without very serious consideration that I took upon myself the step of giving notice of a motion of censure on the Council in connection with the charges brought against Admiral Smyth by Mr. Sadler. I felt sure that if the sense of justice of the Fellows were appealed to they would say at once that this charge ought not to have been brought before the Society, unless some attempts were to be made to substantiate it. As no attempts of that kind were made, it seemed to me most necessary that some vote of censure should be passed primarily, of course on Mr. Sadler, but in a secondary sense on the Council for having allowed Mr. Sadler to disfigure our *Notices* in the way he has done. (Applause.) I am very glad indeed to hear the announcement which has been made by you, my Lord, on behalf of the Council respecting this matter within the last few minutes. It seems to me, therefore, that the ground is cut away from under my feet, because the censure which I as a private Fellow should have asked the Fellows of the Society at large to have passed, has been passed so fully, and certainly so much more powerfully, by the Council, that I cannot for a moment doubt that when Mr. Sadler becomes acquainted with the action of the Council in this matter, he will at once tender his resignation of his seat at the Council. (Applause.) That being so, we shall have secured all that we desired, and we shall have vindicated the memory and character of Admiral Smyth, and that, I think, is a matter dear to the hearts and minds of a very large number of the Fellows of this Society. (Hear, hear.)

Mr. Ranyard: Mr. Chambers will excuse me if I interrupt him to say that he has not, I think, quite taken in the meaning of the resolution. The Council does not vindicate the character of the late Admiral Smyth. It has passed a resolution with regard to the advisability of printing personal accusations in the publications of the Society, but it has not taken any sides in the question, and I think Mr. Chambers is mistaken in attributing that position to it.

Mr. Chambers: Well, my lord, what I feel is this: I have here in a few words, which I feel bound to quote, the terms of the censure passed by Mr. Sadler on Admiral Smyth:—

"It does not argue well for the state of astronomical scholarship that such a 'stupendous fraud,' as one of the first double-star observers has happily termed it, should remain so long undiscovered."

That is a quotation from the *English Mechanic*, which backs

up and endorses the character of the accusations made in the *Monthly Notices*. Therefore I am satisfied to consider that the resolution passed by the Council is virtually a censure passed on Mr. Sadler, for having done a wrong thing at the wrong time, and in the wrong way; and therefore, my lord, I for one do not desire to proceed with the motion of which I have given notice, because I feel that Admiral Smyth's memory, and the justice, honour and integrity of this Society are safe in the hands of the Council after the action it has taken; and if Mr. Sadler feels that, after the resolutions passed by the Council, it is not incumbent on him to tender his resignation as a member of the Council, all I can say is I shall have great difficulty in comprehending the character of Mr. Sadler.

The Astronomer-Royal: My lord, I rise at present merely to express the extreme satisfaction with which I have heard the resolutions of the Council. It is well known to your lordship that I have felt very deeply in this matter. On the one hand, that the state in which things were left by the publication in the *Monthly Notices* of January, without anything following it, was one very dishonourable to the Society. (Hear, hear.) I have felt very painfully indeed that it would be necessary to make some corrections, and I am happy to say that the correction is made entirely to my satisfaction. I am relieved of a load which I cannot express to you. Beyond this I beg to say that I have no part in the controversy with Mr. Sadler. That was no part of mine whatever. My business was with the position in which I, as a responsible member of the Council, stood, and the position in which the Council and the Society were placed by the publication of these papers. Upon investigation I was satisfied that there was a degree of inadvertence—not of intention—in the publication of them, and all I desired was an avowal by the Council that that was the state of things, and I was sure that when they came to look at the real meaning of the papers they would disavow them (hear, hear), and that they would stand in the manly position of saying that they had done a wrong to the public and would set themselves right with the public. I believe that has been done, my lord, effectually by the resolutions which you have read as having been passed by the Council at the recent meeting. For myself I may say, as some slight atonement on my part, that I did take the step of saying that I could no longer remain a member of the Council if the former state of things was continued. I trust the Council will allow me to recall that announcement now. (Hear, hear.) I still am prepared to act in perfect accord with the Council. With regard to the inadvertence to which I allude it has, I believe, arisen from a bad practice in

the transaction of some Council matters, which has been growing up of late years. In the days of old when I was a more active member of the Council than I have been for some time past, the process with regard to papers and communications to the Society was uniformly this: that they were referred to two referees, and these referees gave their opinions deliberately in writing (hear, hear), and in verification of this I cited to the President 37 instances in which I had given my written opinions upon such references. Now, it seems that this system has broken down in the lapse of time, and references have been made and answered in a very loose way indeed. It seems, as far as I can ascertain—though I will not assert the fact—that in this particular instance which has occasioned the unhappy discord in the Society, the paper in question was never seen at all by the first referee, and was only given to the second at a moment's notice with a request to look over it in five minutes and sign it. I believe if the form to which I have alluded had been kept up there would have been no difficulty at all in the matter. I am fully persuaded that due forms of that kind will be maintained in the future. With that reservation, I am entirely satisfied with the explanation that has been given by his lordship, the President, on the part of the Council, and I express myself extremely happy that things have come to this pass. (Hear, hear.)

Mr. Barrow: Before this matter closes, as Mr. Chambers in his notice hinted at censure on the Council, I wish simply to make one remark, for I am sure if he had known what had taken place, anything like censure of the Council would not have entered into his mind. The reason why public notice has not been taken of this matter before to-day was simply that the Council approached the consideration of it—considering it to be a most important question—a month ago, and with that anxiety to arrive at a proper conclusion, and to do justice to all parties which the case demanded, they found their deliberations could not be closed on that occasion, and it was necessary to adjourn the consideration till to-day, and it was on that ground, and that alone, that the Council might have seemed to Mr. Chambers to be taking no action. I feel it to be due to the body of which I have the honour to be a member that that explanation should be known.

Mr. Brett: May I ask why the paper was not forwarded to the referee?

Mr. Ranyard: It was referred to two people; one of them was not present at the time, and could not accept the reference, but it was examined by the other during the meeting, and reported upon in a perfectly formal manner. The whole of the preface of the paper was read to the Council and discussed.

Mr. Brett: Who was it referred to?

The President: I must inform the Fellows of the Society, if they are not already acquainted with the fact, that all questions of reference are strictly confidential. If it were not so it would be impossible to get a just opinion.

Mr. Proctor: I know the Society will excuse me for making a few remarks with regard to a gentleman who is not able to defend himself from what may be regarded as an attack upon him, I mean Mr. Burnham. I think the feeling of those present is that in using the words "stupendous fraud" he intended to imply that Admiral Smyth was guilty of personal fraud. I know Mr. Burnham, and I believe that he is not the man to make any such charge. There is a use of the word "fraud" in America quite distinct from any meaning we attach to it here. (Cries of "Oh" and laughter.) There is no question that they often use the word "fraud" in a sense distinct from our use of it. I may tell you a case which will show this more clearly. There was an English lecturer (I need not mention his name, though the story does not reflect upon him) who gave a course of six lectures, and a friend of mine who had expected there would be a display of optical experiments was disappointed when he found that the lectures (which were the admiration of all America), required a certain amount of thought. My friend said to me, "They were a perfect 'fraud'"; but I said, "Surely you do not intend to reflect on the professor's honesty; you do not mean to say he came here with an unfair purpose." "No, I do not mean that," he said, "but I was thoroughly disappointed," and that is really the sense in which the word is often used in America.

The Astronomer-Royal: Does that apply to the present case?

Mr. Proctor: Yes. Mr. Burnham is a man of extreme modesty; but he thoroughly understands work on double stars. Professor Newcomb has spoken of him as one of the best double star observers. I do not believe he intended to attribute to Admiral Smyth personal fraud. His opinion about Admiral Smyth's book was that it was full of mistakes, and no doubt he spoke with a certain degree of energy, because he had been disappointed in the book. The book is very costly in America. I think it costs 40 or 50 dollars, and he had probably been thoroughly disappointed with it. But I feel sure he could have had no intention of imputing "fraud" as we understand it.

Mr. Chambers: I cannot bring myself to think that Mr. Burnham used the word in any other than the English sense, and I cannot for a moment believe that Mr. Sadler used it in the sense that Mr. Proctor intimates.

Professor Pritchard: Did Mr. Sadler adopt the American

meaning of the word "fraud" or the English? Is he an Englishman or an American?

Mr. Proctor: On that point I am quite unable to give an opinion. It is Mr. Burnham that I am talking of.

The Astronomer-Royal: We are not discussing the character of Mr. Burnham.

Mr. Proctor: It appears to me involved in the discussion. Mr. Burnham being absent, I have felt it a duty to defend him. Though his character is not directly involved, it is indirectly. (Cries of "Not at all.")

Mr. Ranyard: I think that this is a most important question. The meeting has rather been misled by speakers. Of course we have no right to prevent Mr. Sadler making a charge of fraud. It is one of the rights which every scientific critic has, (Cries of "Oh, oh," and uproar.) I trust that those who do not agree with me will hear me fairly. This is an exceedingly important question, and I do not think it is proper to try to silence any speaker by cries of "Oh." I wish, and I hope that others wish, that the Society by this discussion should arrive at a higher sense of what is proper and good criticism, and what is fair criticism. In the future let personalities be avoided, but I cannot feel that it would be a good result, after the excitement and strong feeling which has been shown, if charges of fraud were never allowed to be made. (Cries of "No, no," and disturbance.) Everybody must, I think, agree, that there have been times when such charges have been brought with advantage to science. There is the discussion of the observations of Father Hell, and a remarkable paper by Mr. Hind, upon the observations of Pastorff. If I had been prepared for this discussion I might have looked up several other instances. There was a celebrated discussion with regard to some forged papers which were supposed to have been written by Pascal, and there have been many other occasions when such charges have brought out very valuable information, and have been really useful to science. I think it would not be to the advantage of this Society if any expression of feeling by this meeting tended to suppress such charges entirely in the future. The only question which can be raised is whether such charges are made with malice, and whether they are in unparliamentary language.

Mr. Chambers: I think the complaint is especially not that the charges of fraud have been made, but that they have not in any way been substantiated.

The Astronomer-Royal: I entirely agree with Mr. Ranyard that the examination of scientific papers ought to be perfectly free, but there is a great difference between that and bringing forward accusations of adoption without acknowledgment, and putting in

accusations sideways, irrelevant to the case, and unsupported by evidence. Now, I say, if we had sanctioned such a thing, and had not absolutely contradicted such a system as that, we should have put ourselves in the position of some of those current papers of the metropolis which may properly be called "scientific sewers," (applause) for they are able and willing to receive foulness from all sides, and to distribute it as extensively as possible. It was the peril of that which urged me so strongly in acting as I have done in this matter.

Mr. Freeman: The Council has given the Society satisfaction in this matter, but the Council has admitted a certain amount of negligence in passing this paper communicated to the January number. I have my own views as to the strength of the criticism therein contained. No doubt as a young man Mr. Sadler expressed himself freely, but he was quite ignorant of the author of the "Cycle." In judging of this matter I think we must limit the discussion. The paper is published in our *Monthly Notices*, and we are not at all concerned with what is printed outside the publications of the Society. We need take no notice of the *English Mechanic* or any other newspaper.

Mr. Talmage: I may say how very satisfied the friends of Admiral Smyth are with the action of the Council. I may be permitted to state this, as I think I brought the matter originally before the meeting. Those friends of Admiral Smyth with whom I have been in correspondence feel the most thorough satisfaction, and hope the matter will now drop, and that for the future we shall be better behaved. (Laughter.)

Mr. Neison: It will be in the recollection of the Society that at the March meeting when this matter was brought before us I expressed views which were opposed to the general opinion of the Fellows then present. On the present occasion I have no intention of saying anything further upon the matter, but I think it is only right it should be known that it is only considerations connected with the prosperity of the Society which keep me silent. I feel that if I were to say words which I should otherwise be tempted to say, it would only be an injury to the present welfare of the Society, but I think it should be known that the resolutions which were carried by the Council were not carried without depriving that body of at least one of its members.

The President: If no other gentleman wishes to offer any further remarks, we will proceed with the ordinary business of the Society.

Professor Pritchard was called upon to read a paper *On Sir John Herschel's reference catalogue of multiple and double stars.*

On commencing to read the paper Professor Pritchard said:

There is not a personal word in it. Those astronomers who are seriously engaged, or otherwise interested, in the computation of the orbits of double stars, or are engaged in furnishing data for such investigations, are informed, and are requested to bear in mind, that Sir John Herschel's references to the catalogue of the two Struves apply solely to the catalogues as originally published by those most eminent astronomers, and are independent of the corrections which they subsequently found it necessary to make to the originally printed observations. To working astronomers it may perhaps be unnecessary to add that they will find the corrigenda if they consult the "Positiones Mediæ," page 92, and the Catalogue révu et corrigé des étoiles doubles et multiples, by O. Struve. Sir John Herschel refers to the original catalogues of those two great astronomers as they originally published them. They made in the course of time certain corrections, of which Sir John Herschel in his references has not taken account, but no man seriously engaged in double-star work could, by possibility, be misled, for Sir John Herschel makes a reference to the works, and if a person is engaged in such work he will look and will at once see that subsequently the two Struves did make certain corrections, but as to any confusion, any doubt, or difficulty, it is not possible, except to those persons who are not actually and seriously engaged, and who do not possess the works in question. To such persons the references have no meaning at all. The references are to the works of the two Struves, and they are accessible to any one who possesses the book, and no man can work on double-star work effectually without possessing those books. Now I am here, let me make this observation. This catalogue of Sir John Herschel was placed on the Council table, month after month, and if there had been any doubt as to its utility, there the proof-sheet was, upon the table, and every member of the Council had the opportunity of seeing it, and if he had anything to object to, then was the time, I apprehend, and not afterwards.

Mr. Ranyard: Why did you not correct the misprints and errors which the Struves had corrected?

Professor Pritchard: Sir, if you possess the book, and will look you will undoubtedly find it out yourself. But I will tell you why. Sir John Herschel was an original investigator, and, I suspect, did not so much care for book learning. He took the "Positiones Mediæ," and wrote down what he found. Practically, the reference catalogue was not edited by me, but it was done at the Radcliffe Observatory, and I say it has been done magnificently well, and I defy any man who is an astronomer to come forward and prove that it has not been most carefully edited. Now I will let you into the secret. I did not intend to speak upon this

subject, but now that Sir John Herschel is removed from the sphere of his labours, and we cannot ask him why he did not adopt the corrections. W. Struve's *corrigenda* are not inserted in the usual place, viz., at the beginning or end of his book, but are contained under the head "*Notæ Criticæ*," in the very middle of the volume, and it is possible were overlooked by Sir John Herschel and by Mr. Main. As for the catalogue itself, I am perfectly sure that no working astronomer will tell you that Sir John Herschel's catalogue is worse than others. I think he will admit that it is better, if he become acquainted with it, than the majority of catalogues. I have explained now the source of Herschel's errors, but they are not Herschel's errors; they are the errors of the two Struves, and every mortal astronomer that ever lived must make some errors. The mistake has been made in supposing that any long catalogue of 10,000 stars is to go forth to the world without having mistakes in it, that would be superhuman. Such a thing never was done.

Mr. Ranyard: In editing the catalogue I understand that you did not refer to the corrections, but do I rightly understand you in your paper to say that they were only published subsequently?

Professor Pritchard: I was told that there were some errors made in this catalogue. They are trifling things, and hardly worth bringing up. They are not two per cent. of the whole book, nor one. Therefore this is too trifling. It is a loss of the time to the Society to discuss the thing at all, and I would not now come forward to do it if it had not been for the inuendoes that have been going forward. I know how they have originated, and the Astronomer-Royal has made use of the right word, which I will not repeat. (Hear, hear, and laughter.) That is the source of all this trouble. But you asked me a question. I will answer any question. Your question was what? (Laughter.)

Mr. Ranyard: Am I right in supposing that your excuse for not referring to the corrections of the misprints and errors is that they were published subsequently?

Professor Pritchard: There was a book missing in which Otto Struve had corrected (so it turns out now) the errors he himself had made. We could not find that book. I repeat that, practically, I had little or nothing to do with the editing of this catalogue. It was my dear respected old friend, Professor Main, who was in posession, I believe, of one of the best astronomical libraries in this country. We felt, or I felt, that there was a missing link. Some book appeared to exist which could not be found in the Radcliffe Library. I took upon myself to write to Struve, and ask him for the book, if there were such a book, and he wrote back to state that the book was in the Bodleian Library, but upon going there

it was not to be found. It was neither in the Radcliffe or the Bodleian. Since then we have found the book in Sir John Herschel's possession, in his own library, and any one who will refer to this Recueil de Memoires des astronomes de l'observatoire de Pulkova, will be able at once to make the few corrections which Otto Struve found it necessary to make; but indeed all this turmoil is about nothing at all.

Mr. Ranyard: Did you look in our library upstairs? The book is there.

Professor Pritchard: Yes. I know you have it, and I have it myself now, and that is how I found out O. Struve's Corrigenda. There is no mystery about it.

Mr. Ranyard: Then neither you nor the sub-editor, who was paid so much a sheet to help you, found——

Professor Pritchard: You think the editor ought: but would you if you had 10,000 stars to look through? We did not undertake to do anything of the kind. We merely undertook to reproduce Sir John Herschel's work.

Mr. Ranyard: The printers might have done that. Are we to understand——

Mr. Brett: Come, we have had enough of this.

Professor Pritchard: I think so, too. The catalogue is, in point of accuracy and utility quite equal to that of catalogues in general; that is my feeling.

The Astronomer-Royal: I have the most perfect belief in the sufficiency of the explanation which Professor Pritchard has given, but I hope it will be put in writing.

The President: I wish to say with reference to this work containing the errata alluded to by Professor Pritchard, that it is a matter of difficulty to get hold of a copy. I thought I was fairly well acquainted with the writings of Struve and the places where the writings appeared, but pride will have a fall, and I must say that when I published in the first volume of the Dun Echt observations a review of Struve's double stars, I was not aware of these corrections, consequently they do not appear in it. But all the criticism I have seen of it has been kind, and I have not been abused for not having noticed the errata; they will be published in a future volume.

Mr. Knobel: With reference to the book referred to by Professor Pritchard, Mr. Ranyard states that it is in the library, but I think I found it in the top gallery four years ago, tied up with other papers, where it was lost sight of.

The President: Is it your pleasure to return thanks to Professor Pritchard? (Hear, hear.)

Mr. Christie read a paper *On the spectrum of Brorsen's comet,*

observed at the Royal Observatory, Greenwich. He said: This is a short note on the spectrum of Brorsen's comet which we thought might be interesting to the Society. The chief point of interest in regard to this comet is that Dr. Huggins, in 1868, on its previous return to perihelion found a spectrum which differed from that which had been observed from other comets. We have therefore examined this spectrum with special interest, and I may mention that Professor Young, in America, has also examined it. He found that the three principal bands of the spectrum coincided with the three principal bands of the flame spectrum of a hydro-carbon—that is the spectrum of the first order of carbon. Before we were aware of Professor Young's observations we made some observations of the comet compared with the spectrum of an alcohol vacuum tube, which gives a spectrum of the second order of carbon; and we found that as regards the green band, the comet band was sensibly in the same place as that of the carbon spectrum of the second order. And since that, further observations have been made by Mr. Maunder, showing that the band in the yellow is also co-incident with the band in the spectrum of an alcohol vacuum tube, and that the band in the blue is somewhere near the corresponding band in the spectrum of carbon-oxide and alcohol. The interest that arises with regard to the spectrum of this comet is that there are two spectra of carbon, viz:—spectrum given by the blue part of a Bunsen burner flame and that by a vacuum tube containing carbon-oxide or alcohol. We found that the spectrum of this comet coincides with the second spectrum of carbon, whilst Professor Young appears to have found within the limits of his observations the spectrum of the comet to be coincident with the first spectrum. We made similar observations of Coggia's comet, showing the two principal bands of that comet to be sensibly coincident with the two corresponding bands of the spectrum of the second order of carbon. I will try and show on the black board what the issue really is:—

	Yellow band.	Green band.
Comet	5580	..... 5191, 5190
Alcohol vacuum tube	5610	 5198
Blue flame	5635	 5165

The President said he had received a communication from Dr. Copeland, giving the results of spectrum observations of the comet on April the 16th and May 2nd and 3rd. There were three bright bands, the brightest part of which were given by him as —

(No. 1.)	547·6
(No. 2.)	515·6
(No. 3.)	469·6

2 and 3 were sharply defined on the less refrangible sides, fading towards violet end. No. 1 was ill-defined on both sides. The best coincidence of Dr. Copeland's lines was his 515 against Mr. Christie's 519.

Mr. Christie thought there should not be an uncertainty so large as that. He estimated the uncertainty at a fraction of 30 tenthmetres.

The President said he must admit that Dr. Copeland's instrument was not extraordinarily accurate.

Dr. Schuster thought Mr. Christie had used the term spectrum of the first and second order, with reference to the spectrum of comets, in a slightly different sense to that generally used. No doubt there existed a spectrum of the first order of carbon, but he did not think Mr. Christie had seen it. It was got with some difficulty. There were two spectra; one was seen at the base of any blue flame. He would not say whether this spectrum was hydro-carbon, but at any rate the bands were made up of single lines, and it was this which was called the spectrum of the blue flame. There was another of alcohol. He thought if the alcohol had been perfectly pure Mr. Christie would not have seen it. It is a spectrum of carbonic oxide. The bands are slightly displaced. There is another spectrum of carbonic acid which is slightly different again. The green bands in the carbonic oxide tube are sharply defined at the edge, gradually fading away. In the blue flame what seems to be the true carbon spectrum breaks up into two strong lines. In the Greenwich yellow part there are a number of substances that give bands there which might easily be mistaken for it. For instance, amongst the metalloids—the oxygen tube and the aurora line—there are three different spectra that you can hardly distinguish with a dispersion of one prism from one another. If you were to take the metals you would find a great many more very much alike. The line which Mr. Christie says corresponds to carbonic oxide is the one which is coincident, and not the blue line, which I believe is due to pure carbon vapour, and which some believe due to hydro-carbon.

Captain Noble asked whether an ephemeris of any object such as Brorsen's comet could not be sent on a post-card to members.

The President: I have had the matter under consideration for some little time past, and I hope before the general meeting I shall have some scheme ready to lay before the Society.

Mr. Banyard: There are two other little papers on Brorsen's comet, both from Australia, by Mr. Tebbutt and Mr. Russell.

Mr. Neison read a paper *On determining the solar parallax from inequalities of the moon*, the object being to direct attention to a method not liable to the objection of the present method. The method recommended is to take the term of long period, which takes about 400 days to go through its revolution. It was not liable to the error of the present method, and could be determined with greater certainty to within one 100th of a second of arc. The paper gives the result of the reduction of nearly 1,500 observations made at Greenwich with the transit circle between 1862 and 1876.

Mr. B. Inwards exhibited the model of an observing chair, which he had designed for the comfort of astronomers, giving a series of more or less suitable angles, for observing with a transit instrument, but it was not intended to be of universal use for all kinds of work.

Captain Noble said that, as the observer's eye could never be raised higher than if he were sitting in an ordinary chair, Mr. Inwards's invention must be useless if employed with a telescope of any considerable focal length; especially when viewing an object near the horizon.

Mr. Brett called attention to the fact that the planet Venus was just now particularly favourably situated for observing specula reflection. Most people could see it immediately, but for those who could not a dark wedge will be found to demonstrate it very satisfactorily,

Mr. Knobel called Mr. Brett's attention to the United States and the Cape observations of Venus on the 26th April, in which no mention was made of the bright spot which Mr. Brett pretended to have seen. (Laughter.)

Mr. Brett: Astronomers have looked at Venus for 1800 years without discovering it, and therefore it is not surprising that at Washington they have not noticed it.

Mr. Neison gave a description and showed a diagram of Klein's new crater in the moon, which Mr. Neison had succeeded in observing on the 28th of April. It was a most distinct object on that date, and had been seen and drawn by Mr. Green, and the two drawings agreed exactly.

Mr. Green said that instead of the large vague dark spot shown in the Melbourne photograph he saw, on the occasion in question, a distinct dark spot as Dr. Klein had stated. It was utterly impossible to have overlooked it. It seemed to be a portion of a larger dark mass.

The following papers were also announced and laid on the table:

W. F. Denning: *Meteor radiant points of April 9—12.*

W. F. Denning: *Catalogue of 222 stationary meteors.*

Lord Lindsay: *Observations of Brorsen's comet.*

J. J. Astrand: *Two short and easy methods of correcting lunar distances.*

O. von Struve: *Order of publication of successive volumes of the "Observations de Pulkova."*

The meeting adjourned at a quarter to ten o'clock.

REVIEW.

Astronomical Observations made at the University Observatory, Oxford, under the direction of C. Pritchard, M.A., F.R.S., F.G.S., F.R.A.S., Savilian Professor of Astronomy in Oxford. No. I. Oxford: at the Clarendon Press. 1878. pp. 64.

Contents: Observations of Saturn's satellites at the oppositions of 1875—6—7. 2. Observations of double stars in the years 1876 and 1877, and mean results. 3. Observations of the comets of Borelly, Winnecke, Swift, Coggia, and Tempel in the year 1877, with provisional elements (parabolic) computed at Oxford in 1877; ephemeris of comet of Winnecke compared with observations. 4. Elements of the orbits of ξ Ursæ Majoris, 70 Ophiuchi, and μ^2 Boötis.

The main object of this institution is to "provide the University students with the means of efficient instruction in practical astronomy, while at the same time the professor shall have at his disposal adequate instrumental appliances for extending the science by actual observation." The equatorial telescope used in the observatory is a fine achromatic of 12¼-in. aperture, and about 14½-ft. focal length, provided with every accessory that could be suggested by present astronomical and constructional science; the entire equipment having been executed by Mr. Howard Grubb, of Dublin. It is hoped that the extensive series of observations of the satellites of Saturn may be of service to some astronomer who shall undertake a re-investigation of their orbits; and the valuable and accurate ephemerides of them, regularly supplied by Mr. Albert Marth, are gratefully acknowledged. 400 observations were taken of double stars. In future it is intended to confine these observations to a few stars only, and to observe these select objects repeatedly and carefully. Many of the comet observations were made by a peculiar reticule devised by Mr. Hind, which has been found of great utility for rapid and approximate observations. The elements of the orbits of these double stars, selected from a larger number already calculated, have been computed with considerable pains. The method employed by Prof. Pritchard is as follows: an approximate orbit is first obtained by the graphical method of Sir John Herschel. "This being effected . . . a comparison is made between the places of the companion on the elliptical orbit thus obtained, and the correct places designated by the interpolation curves. Five places are then selected, either on, or very near to, the ellipse itself, or more generally, five places are selected intermediate between the curve and the places, as given by the interpolation curves; the elements of the ellipse are then accurately *computed* by an algebraical process from these five places thus selected. The method thus adopted appears to have the advantage of a species of second approximation, and in its results has so far proved itself to be an improvement on the simply graphical method." We should like to see a pamphlet in which an example or two of this process is worked out from beginning to end *in extenso*. It might furnish

useful occupation to some amateurs. Experience in this "very interesting but very troublesome work" has led the Professor to the conclusion that "the *accurate* determination of the orbit of a double-star remains for the astronomy of the future," and it is on this account that in future only a very few select double-stars will be observed at the University Observatory.

Some observations of the satellites of Mars have been attempted, but the illuminating power of the Oxford telescope is hardly sufficient to cope with such faint objects. With Dr. De La Rue's admirable reflector, which he presented to the University, nearly 1200 measurable photographs of the moon have been taken. A very beautiful engine for completing the measurements of these photographs has recently been presented by the same generous individual. The greater part of the observations in this *fasciculus* were made by Mr. W. E. Plummer. The lunar photographs were taken by Mr. C. A. Jenkins. Of these gentlemen the Savilian Professor says, "The assiduity and skill with which the assistants have done their work will be sufficiently attested by the fact that it is but little more than two years ago that the observations were begun, and that they have been reduced and are here recorded up to the commencement of the present year."

Praise is superfluous after an examination of this first series of observations; and instead of well-deserved encomiums we shall conclude this notice by appending the elements of the orbits of the three double stars, which the accompanying table of comparison with interpolation curves (which we are obliged to omit) shows have now been obtained with a considerable degree of accuracy.

ELEMENTS OF ξ URSÆ MAJORIS.

Date of perihelion passage	T	1875-26
Period of revolution	P	60·80 years
Position of node	Ω	100°·13′
Inclination of orbits	γ	56·40
Angle between Axis Major and line of nodes...	λ	235·0
Excentricity of orbit	ε	0·41590
Semi-axis Major	a	2″·580

ELEMENTS OF 70 OPHIUCHI.

T	...	...	1808·90	γ	...	...	58°·5′
P	...	...	94·44 years	λ	...	...	151·55
Ω	...	...	127° 23′	ε	...	...	0·46718
				a	...	...	4″·790

ELEMENTS OF μ^2 BOÖTIS.

T	...	...	1862·55	γ	...	...	35°·12′
P	...	...	266·0 years	λ	...	...	40·54
Ω	...	...	166°·7′	ε	...	...	0·56685
				a	...	...	1″·057

New Solar Elements, By Rev. G. T. Carruthers, Chaplain of Nagpur. Nagpur: Printed at the Chief Commissioner's Office Press. 1879.

The lucubrations of Mr. Carruthers were noticed in the *Astronomical Register*, No. 13, page 264, and we can add nothing to what we then wrote. He merits, however, the praise of candour in the avowal, "I fairly confess that I still see through a glass darkly." Very darkly indeed, we should say, and cannot but regret that interest and trouble, which, perhaps, if well directed, might advance science, should be wasted—we say it in no unkind spirit—in unprofitable, not to say visionary speculation.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.
To all communications must be annexed the name and address of the sender, as a guarantee of good faith.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

RED SPOTS ON JUPITER.

Sir,—All who interested themselves with the planet Jupiter during its last opposition period must have read M. Niesten's note, communicated to your May number by your correspondent, Mr. H. J. Slack, with a keen appetite. I have prepared the following table of the observations of the red spot from the letters of Prof. C. W. Pritchett, of the Glasgow (U.S.) Observatory, and M. E. L. Trouvelot, of Cambridge (U.S.), in *The Observatory* for January and April; of Mr. Niesten, in the *Astronomical Register* for May, and from my own note books.

	d.	h.	m.		h.	m.		°	°	
1878. July	9	12	18	Gl.M.T.	18	36	G.M.T.	222	239	P.
	27	13	0	G.M.T.	13	0	G.M.T.	212	204	D.
Aug.	6	10	45	B.M.T.	10	28	G.M.T.	187	?	N.
	8	12	40	B.M.T.	12	23	G.M.T.	198	?	N.
Sept.	2	8	30	B.M.T.	8	13	G.M.T.	213	?	N.
	25	6	30	C.M.T.	11	14	G.M.T.	186	194	T.
	28	8	50	G.M.T.	8	50	G.M.T.	190	210	D.
Oct.	8	8	10	G.M.T.	8	10	G.M.T.	230	205(?)	D.
	10	7	40	G.M.T.	7	40	G.M.T.	155	close limb	D.
	10	8	30	G.M.T.	8	30	G.M.T.	185	near limb	D.
	25	6	30	G.M.T.	6	30	G.M.T.	209	239	D.
Nov.	11	5	30	G.M.T.	5	30	G.M.T.	209	240(?)	D.
	23	5	5	G.M.T.	5	5	G.M.T.	199	240(?)	D.

The first column gives the time given by the observer; the second, the same reduced to G.M.T.; the third, the longitude of the central meridian; the fourth, the approximate longitude of the centre of the red spot; and the last, the initial of the observer. When first I saw the spot, July 27, 1878, it appeared "of the same tint as the N. equatorial belt ['decidedly copper coloured, reddish'], though less vividly," to which I may add that the equatorial belt was darker. A 9¼-in. "With." was used. The later observations were made with a 5¼-in. "Calver." On Sep. 28, my note says:—"The colour of the N. equatorial belt is still very conspicuous, a decided copper, which now contrasts somewhat with the pinkish tint of the patch in the S. temperate

zone." On Nov. 23, I noted "the pink colour of this neighbourhood [*i.e.*, the spot] was very marked sometimes, and was the most highly tinted portion of the disk." From these notes I cannot but infer that the tint of the spot must have altered by losing the admixture of yellow, and likewise have increased in brilliance. From the reading of M. Trouvelot's letter one would almost think he were writing under the impression that Jupiter did not revolve on its axis. The central meridians of the spots in some of my observations it will be noticed are queried, that is because I fancy the spot was in those cases shown too large on the drawings, except in the last two cases, where the spot seemed to continue to the limb as though it were the western portion of a belt. But the list of observations seems to indicate a retrogressive motion to the spot. If M. Trouvelot could oblige observers with the dated sketches accompanying his later observations they would in all probability settle this point, which is a very interesting one. It need scarcely be added that the longitudes given above are calculated from those of Mr. Marth published in the *Astronomical Register*.

F. C. DENNETT.

Dr. KLEIN'S NEW CRATER NEAR HYGINUS.

Dear Sir,—On the 28th April I had a good opportunity of examining this portion of the lunar surface, and an excellent view of the dark spot considered by Dr. Klein to be a new marking. Its appearance agreed closely with the description and drawing in the *Register* of November, 1878. There was no difficulty in seeing it, though I should not describe it as black, and its size was certainly larger in proportion to the surrounding objects than in the small map in the *Register*. The spot was seen faintly on the 29th, and on the 30th could only be seen with difficulty, after which it disappeared. This mark is evidently no hollow or crater, for its ridge, if any, is of the faintest description. It seems rather a spot of colour than a crater, but this cannot be the case, as it is lost when the sun rises.

I am not sufficiently acquainted with this portion of the moon to have any opinion about its recent character, but would offer a suggestion upon the cause of its visibility with a low sun, and subsequent disappearance. If this spot is or has become less rough than the surrounding surface it would appear and disappear as observed. When the sun was rising it would be a spot much darker than the rougher surroundings, and this darkness would fade away as the angle of illumination increased.

The smoothing of the surface might be occasioned by a recent

overflow of lava, or might result from a crumbling down of previous irregularities, but if from any cause its roughness has been reduced, it would then make its appearance as described by Dr. Klein.

39, Circus Road,
St. John's Wood.

Yours respectfully,
NATHL. E. GREEN.

SILVERED MIRROR TELESCOPES.

In reference to the discussion about silvered mirror telescopes, let me say that my 6¼-inch equatorially mounted was the first of the With-Browning series, so that few persons in England have had a longer experience than mine with this construction. The loss of light from transit is very slight, and I found the tendency to tarnish exceedingly small when I lived on the north side of London, and merely covered up the end of the telescope, rarely putting a cover immediately over the mirror. With an occasional polish, using a soft leather and a little rouge, the silver does not require renewing under four or five years, and then only because portions of it have come off, and some light is lost in consequence.

When the film of silver is perfectly dry, it bears rubbing like a tea-spoon, but there are usually some parts where the adhesion is less perfect, and they give way. Touching it when damp, or wet from an accidental raindrop, is sure to do harm and remove some metal.

My first observatory, opening out of a drawing-room, was nearly all glass, with curtains to keep out excess of sunshine. My present one, in use for the last nine years, consists of painted canvas stretched over a wooden frame made strong with T iron. The whole edifice revolves on a circular rail, and its doors and sliding-roof opening are 28 inches wide. Both these constructions facilitated equalization of temperature between the internal and external air, and minimised chimney currents. I have known several cases of failure—and heard of many more—to get good performance out of reflectors that have been placed in observatories with thick walls. The walls should be thin, the opening pretty large and come down low, and the size of the observatory such that the mouth of the telescope comes near it. If an observer is surrounded by a thick wall, several feet high, and points the telescope towards a hole in the roof, the chimney currents are certain to be vexatious. This error should be avoided, and it is desirable that the observatory should be raised ten or twelve feet above the ground.

I remain, &c.,

Ashdown Cottage, Forest Row, Sussex.

HENRY J. SLACK.

ASTRONOMICAL OCCURRENCES FOR JUNE, 1879.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sun	1	18	Jupiter at quadrature with the Sun Sidereal Time at Mean Noon 4h. 38m. 23·558.	2nd Sh. I.	14 29	δ Ophiuchi. — 11 27·8
Mon	2		Sun's Meridian Passage 2m. 19·33s. before Mean Noon			11 23·8
Tues	3	8 22	Near approach of B.A.C. 5347 (5)	2nd Oc. R.	15 13	11 19·9
Wed	4	1 35	○ Full Moon	1st Ec. D.	14 28 40	11 15·9
Thur	5			4th Tr. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	13 1 13 10 14 7 15 29	11 12·0
Fri	6	14 14 14 31	Occultation of B.A.C. 6699 (6½) Reappearance of ditto	1st Oc. R. 3rd Tr. I.	12 37 13 22	11 8·1
Sat	7					11 4·2
Sun	8					11 0·2
Mon	9		Saturn's Ring: Major axis=38″·06 Minor axis= 6″·49			10 56·3
Tues	10	17	Conjunction of Moon and Jupiter 5° 23′ S.			10 52·4
Wed	11	4 56 13 6 13 50	☾ Moon's Last Quarter Occultation of λ Piscium (5) Reappearance of ditto			10 48·4
Thur	12	12	Conjunction of Moon and Mars 7° 45′ S.	1st Sh. I. 1st Tr. I.	13 40 15 2	10 44·5
Fri	13	11	Conjunction of Moon and Saturn 8° 6′ S.	4th Ec. R. 1st Oc. R. 3rd Sh. E.	12 11 28 14 30 15 24	10 40·6
Sat	14					10 36·6
Sun	15	13 50	Occultation reappearance of μ Arietis (5½) Illuminated portion of disc of Venus=0·636 Illuminated portion of disc of Mars=0·846			10 32·7

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Mon	16		Sidereal Time at Mean Noon 5h. 37m. 31·92s.			δ Ophiuchi. 10 28·8
Tues	17		Sun's Meridian Passage om. 32·54s. after Mean Noon	2nd Ec. D	14 47 14	10 24·8
Wed	18	12	Superior conjunction of Mercury and Sun			10 20·9
Thur	19	8 19	● New Moon	2nd Sh. E.	11 55	
		11	Conjunction of Moon and Mercury 1° 4′ S.	2nd Tr. E.	14 32	10 16·9
				1st Sh. I.	15 34	
Fri	20			1st Ec. D.	12 45 13	10 13·0
				3rd Sh. I.	15 44	
Sat	21			1st Sh. E.	12 22	
				1st Tr. E.	13 40	10 9·1
Sun	22					10 5·2
Mon	23	10 14	Occultation of ξ Leonis (6)			
		5	Conjunction of Moon and Venus 4° 1′ N.			10 1·2
Tues	24			3rd Oc. R.	14 24	9 57·3
Wed	25					9 53·4
Thur	26	17 15	☽ Moon's First Quarter	2nd Sh. I.	11 37	
				2nd Tr. I.	14 10	9 49·4
				2nd Sh. E.	14 31	
Fri	27			1st Ec. D.	14 39 18	9 45·5
Sat	28	11 2	Occultation of 87 Virginis (6)	1st Sh. I.	11 57	
				2nd Oc. R.	11 59	
				1st Tr. I.	13 12	9 41·6
				1st Sh. E.	14 16	
				1st Tr. E.	15 31	
Sun	29		Saturn's Ring : Major axis=39″·33 Minor axis= 7″·02	1st Oc. R.	12 40	9 37·6
Mon	30	12 16	Occultation of *b* Scorpii (5)			
		13 1	Reappearance of ditto	4th Oc. D.	13 39	9 33·7
		8	Conjunction of Saturn and Mars 0° 1′ N.			
JULY				3rd Ec. R.	13 8 35	
				3rd Oc. D.	14 38	9 29·8
Tues	1					

THE PLANETS FOR JUNE.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury...	1st	3 26 21	N.16 55½	5″·9	22 44·3
	9th	4 29 5	N.21 25½	5″·3	23 15·3
	17th	5 43 18	N.24 23	5″·0	23 57·9
	25th	6 50 4	N.24 41½	5″·1	0 37·0
Venus ...	1st	7 34 12	N.23 59	15″·9	2 52·3
	9th	8 12 38	N.22 14½	16″·8	3 2·2
	17th	8 49 13	N.19 56	17″·9	3 7·2
	25th	9 23 44	N. 17 9	19″·2	3 10·2
Mars ...	1st	23 45 48	S. 3 48	9″·0	19 4·3
	9th	0 6 50	S. 1 37½	9″·4	18 53·8
	17th	0 27 34	N. 0 31	9″·9	18 43·0
	25th	0 47 59	N. 2 36½	10″·2	18 31·9
Jupiter ...	1st	22 52 34	S. 8 17	37″·7	18 11·2
	9th	22 55 2	S. 8 4½	38″·5	17 42·2
	17th	22 56 48	S. 7 56	39″·7	17 12·5
	25th	22 57 49	S. 7 52½	40″·5	16 42·1
Saturn ...	4th	0 53 15	N. 3 13	15″·2	19 59·7
	9th	0 54 9	N. 3 17½	15″·2	19 41·5
	17th	0 56 49	N. 3 32	15″·4	19 12·2
	25th	0 58 36	N. 3 41	15″·7	18 42·5
Uranus ...	2nd	10 10 54	N.12 3	4″·0	5 27·7
	18th	10 12 39	N.11 52½	4″·0	4 26·5

Mercury is not favourably situated for observation. He rises about forty minutes before the sun at the beginning of the month, and sets about an hour after the sun on the last day.

Venus sets three hours and eleven minutes after the sun on the 1st, the interval decreasing to about two hours and a quarter on the last day.

Mars rises, on the 1st, about an hour and a half after midnight, the interval decreasing. At the end of the month he rises about midnight.

Jupiter rises rather less than an hour after midnight, at the beginning of the month, the interval decreasing. He rises about an hour before midnight on the last day.

Saturn rises about two hours after midnight at the beginning of the month, the interval decreasing. On the last day he rises about midnight.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JUNE, 1879.

BY W. R. BIRT, F.R.A.S., P.S.S.

Vol. XVI. p. 268 of the *Astronomical Register* contains a map of the region near Hyginus from *Sirius*, in which will be found the following objects inserted in "Lunar Chart No. 1," of the Selenographical Society, published with No. 6 of the Journal; Hyginus; N. the new crater, near Hyginus; *x*, *s*, *y*, forming a triangle west of Hyginus; two craters further to the west of C and *p* of the chart; the two craters *a* and *b* south-east of Hyginus, being nine altogether. On the 28th of April, 1879, Mr. Burnham, of Chicago, observed the region and measured the position angles and distances of eight of these objects, viz.:—Hyginus; C and *p*; *k* and *s*; N.; *a* and *b*. It does not appear that Mr. Burnham saw the

crater *y*, forming the apex of the triangle with *k* and s, but he inserts the craterlet *q*, which is shown as a triple object on the map from *Sirius*, and which has been seen by Miss Ashley as a single white spot. The objects identified by Mr. Burnham are, therefore, Hyginus; C; *p*; *k*; *s*; N; *a* and *b*; nine of Lunar Chart No. 1.

It is important that the craterlet *y* should be looked for, as Mr. Burnham missed it; also the triplicity of *q* ascertained; it is further necessary that for the measurement of position angles and distances a *fiducial line* should be chosen and the angles reckoned from N. to E. = 0° to 90°; E. to S. = 90° to 180°; S. to W. = 180° to 270°; W. to N. = 270° to 360°. The objects Hyginus—*b* would form a very convenient fiducial line, and the position angles and distances to be determined are as follows:—Hyg. *b*; Hyg. *a*; Hyg. C; Hyg. *p*; Hyg. *q*; Hyg. *k*; Hyg. *s*; Hyg. N.

No information has come to hand relative to the dark spot 1 A η 7, mentioned in our last list on p. 124, May number.

Water Lane, Stratford, E.:
May 21, 1879.

JUPITER.

1879. oh. Gr.	Angle of position of 4's axis.	Latitude of Earth above 4's equator.	Latitude of Sun above 4's equator.	Equat. diameter.	Greatest phase.
	°	°	°	″	″
June 4	335·44	+1·24	+0·78	40·13	0·42
14	335·36	+1·32	+0·82	41·45	0·42
24	335·31	+1·38	+0·87	42·81	0·39

The assumed First Meridian passes the middle of the illuminated disk at the following times:

1879. G. M. T.	h. m.		h. m.		h. m.
June 1	5 42·3	June 11	3 55·1	June 21	2 3·6
	15 37·7		13 48·6		11 59·0
2	1 33·2		23 44·0		21 54·4
	11 28·7	12	9 39·5	22	7 49·9
	21 24·1		19 34·9		17 45·3
3	7 19·6	13	5 30·3	23	3 40·7
	17 15·0		15 25·8		13 36·1
4	3 10·5	14	1 21·2		23 31·5
	13 5·9		11 16·7	24	9 27·0
	23 1·4		21 12·1		19 22·4
5	8 56·8	15	7 7·5	25	5 17·8
	18 52·3		17 3·0		15 13·2
6	4 47·7	16	2 58·4	26	1 8·6
	14 43·2		12 53·9		11 4·1
7	0 38·6		22 49·3		20 59·5
	10 34·1	17	8 44·7	27	6 54·9
	20 29·5		18 40·2		16 50·3
8	6 25·0	18	4 35·6	28	2 45·7
	16 20·4		14 31·0		12 41·2
9	2 15·9	19	0 26·4		22 36·6
	12 11·3		10 21·9	29	8 32·0
	22 6·8		20 17·3		18 27·4
10	8 2·2	20	6 12·7	30	4 22·8
	17 57·7		16 8·2		14 18·2

A. M.

BRILLIANT METEOR.

A very splendid meteor was seen by Padre Denza and others on the evening of January 12th, at the observatory of Moncalieri. It appeared near Regulus at 9h 56m. local mean time, and slowly skirting the line formed by the stars α, ρ, χ Leonis, disappeared near σ. Very small at first, its size increased rapidly to about 7 minutes of arc, or rather less than the fourth part of the diameter of the full moon. It gave a very vivid light, like a flash of lightning, overpowering the moonlight. The nucleus had a golden white colour, very brilliant, and was surrounded by a lucid whitish-emerald atmosphere. It was followed by an azure streak which lasted a second or two after the extinction of the nucleus. The duration was about 3 seconds.

Books received.—Double Stars discovered by Mr. Alvan G. Clark. By S. Burnham. 1879.—Dreams of my Solitude on the Mysteries of the Heavens. By Joshua Prusol. London: Reeves and Turner. 1879.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To May, 1877.
Ingall, H.

To June, 1879.
Metcalfe, Rev. W. R.

To Sept, 1879.
Jones, W. E.

To Dec., 1879.
Wilson, T.

To Jan. 1880.
Daw, E.

To March, 1880.
Matthews, Rev. W.

To April, 1880.
Proctor, R. A.

TO CORRESPONDENTS.

We cannot publish communications which are not authenticated by the name and address of the sender, as a guarantee of good faith.

When subscriptions sent by post are not acknowledged in the next number, the Editor will be much obliged if subscribers will *at once* inform him of the fact.

All Letters requiring an answer must enclose a penny stamp.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or *penny* postage stamps, but the Editor will not be liable for loss in transmission.

Post Office Orders for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage to all parts of Great Britain and Ireland) is fixed at **Three Shillings** per Quarter, *payable in advance*, by Penny postage stamps or otherwise. Subscribers in America may remit, either by post office order or in notes, 3½ dollars, in payment of one year's subscription, postage included.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON, 11, *Angel Court, Throgmorton Street, E.C.*, **not later than the 20th of the Month.**

The Astronomical Register.

No. 199. JULY. 1879.

THE ROYAL OBSERVATORY.

The annual Visitation of this Observatory took place on Saturday, June 7, in the midst of a continuous downpour of rain, of course entirely preventing observations of any sort, beyond that of the pluviometer. Those who had the opportunity of attending had, therefore, the pleasure only of examining the elaborate instruments by which so many valuable results have been obtained.

The annual report which the Astronomer-Royal presented to the Board of Visitors, embraces the period of thirteen lunations, from 1878, May 2, to 1879, May 20. From this we gather that preparations have been made for the erection of the new Library, the necessity for which was pointed out in last year's report. The Library now contains 7,400 volumes, exclusive of pamphlets, and of more than 4,000 bound volumes of manuscripts. Of the instruments that were used in the transit of Venus observations, one photoheliograph and one equatorial are at the South Kensington Museum, whilst one photoheliograph is in daily use at the Royal Observatory, another is at the Cape of Good Hope Observatory, and a fourth is lent to the Indian Government. Arrangements have been made for regulating a clock which shall give seconds' signals on the chronograph. Considerable alterations have been made in the great equatorial. In order to adapt Mr. Christie's half-prism spectroscope, which is a very long instrument, and which is used for almost all spectroscopic observations, to the telescope, it has been found necessary to shift the latter longitudinally thirty inches in its cradle. This, of course, has necessitated the application of an additional counterpoise at the eye-end. Owing to the peculiar mounting of the equatorial, it

can be made available for eye observations by reversing it in hour-angle. Several improvements have been made in the spectroscope itself, and in the spark apparatus for comparison-spectra.

The usual course of astronomical observations has been adhered to, with respect to the minor planets; the Astronomer-Royal reports that through the representations made by him to the Berlin authorities, he has now a most admirable ephemeris. With the transit-circle 4284 transits were observed (the separate limbs being counted as separate observations); with the reflex-zenith-tube 35 pairs of observations of γ Draconis were made; while with the alt-azimuth 733 azimuths of the moon and stars and 368 zenith distances of the moon, were observed. The number of observations would have been greater had it not been for the remarkably bad weather which we had during the past winter and spring, and for the alterations already mentioned, which have been made to the great equatorial; from the former cause not a single observation of the moon on the meridian was possible between January 8 and March 1. Neither sun nor stars were visible for eleven days, during which period the clock-times were carried on by the preceding rate of the clock. The accumulated error at the end of this time did not exceed three-tenths of a second. On five of the seven days on which the sun's chromosphere was examined, prominences were seen. The photographs that were taken on 121 days out of 150 show a complete absence of spots, whereas in the preceding year there were no spots on 66 days out of 156. Thomson's Electrometer has taken the place of the older instruments, and its results recorded photographically, as well as those of the magnetometers, barometer, and thermometers. The approximate mean westerly declination of the magnetic needle for 1878 is 18° 49′; the mean horizontal force is 3·905 in English units, corresponding to 1·801 metric units, and the mean dip (taking the mean of the mean of three needles of different lengths) 67° 38′ 7″.

The annual magnetic curves of diurnal inequality are now complete for the period of 36 years, from 1841 to 1876, and the Astronomer-Royal remarks that from this long series of observations, all made on the same system and with similar instruments, most important inferences may be drawn, both as to the laws of diurnal inequality in general and its changes in different years and seasons, and as to the connection between magnetic phenomena and sun-spots. About the epoch of the maximum of sun-spots the curves are large and resemble those for the summer months; whilst at the opposite epoch, they are small and resemble those for the winter months. This connection between terrestrial

magnetism and sun-spots is shown in a still more striking manner by a comparison between the monthly means of the diurnal range of declination and horizontal force, and Dr. R. Wolf's "relative numbers" for frequency of sun-spots. It appears from this that there is a remarkable general correspondence in the two sets of phenomena.

The mean temperature of the year 1878 was 49°·6, being 0°·2 above the average of the preceding 37 years: it was above the average in every month except September, November, and December. The highest temperature was 85°·8 on June 26, the lowest 12°·2 on December 25. Campbell's Registering Sun-dial is now used for recording the duration of sunshine.

There are now 167 chronometers in the chronometer room. With reference to the Westminster clock, the Report states that it does not seem to have been quite so well regulated as usual. During the period referred to in the Report, its error exceeded 1s. on 77 days, on 15 of these it was between 2s. and 3s., on 4 between 3s. and 4s., and on one day it exceeded 4s.

With respect to the Transit of Venus, Sir G. Airy says that the general impression appears to be that it will be best to confine observations to simple telescopic observations or micrometer observations at ingress and egress, if possible at places whose longitudes are known. For the first phenomenon (accelerated ingress) the choice of stations is not good; but for retarded ingress, accelerated and retarded egress, there appears to be no difficulty. The adoption of a South-Polar station seems to be practically abandoned. The Numerical Lunar Theory is advancing, and the Astronomer-Royal is now engaged on the change of excentricity of the Solar Orbit and its result in producing Lunar Acceleration.

The Report concludes with the expression of a hope that the value of the results obtained at the Royal Observatory is commensurate with the increased annual expense.

ROYAL ASTRONOMICAL SOCIETY.

Session 1879—80.

Last Meeting before the Long Vacation, June 13th, 1879.

Prof. Cayley, F.R.S., &c., *Vice-President*, in the Chair.

Secretaries—Mr. Glaisher and Mr. Ranyard.

The minutes of the preceding meeting were read and confirmed.

The Rev. Daniel Ace, D.D., of Laughton Vicarage, Gainsborough,

was balloted for and duly elected a Fellow of the Society.

Prof. Adams gave an account of a French paper by M. Souillart *On the analytical theory of the movements of Jupiter's satellites.* The paper will be printed in the *Memoirs* of the Society.

Dr. Draper was then called upon to read his paper *On the coincidence of the bright lines of the oxygen spectrum with bright lines in the solar spectrum.* He said: I intend in this paper to speak of the steps that led to the discovery of oxygen in the sun, and to describe some of the successive improvements of the electrical and optical apparatus employed. My first spectrum photographs were taken with a couple of Bunsen batteries, an induction coil giving a spark of $\frac{1}{2}$-in., and a Hofmann direct-vision spectroscope. The length of the spectrum from G to H was about $\frac{1}{2}$-in. On examining a series of photographs of the fluted spectrum of nitrogen, taken with a juxtaposed solar spectrum, I was struck with the coincidence of some of the bright bands in the two spectra, and pursued the subject further. The electrical part was made more and more powerful as the research proceeded. At first I made use of a 2-in. induction coil, then of a 6-in., and this was in turn succeeded by a Ruhmkorff coil capable of giving a spark of 17-in., and the battery was eventually superseded by a Gramme dynamo-electric machine, which can produce a current powerful enough to give between carbon points a light equal to 500 standard candles. When this machine is properly applied to the 17-in. induction coil, it will readily give a thousand 10-in. sparks per minute. These being condensed by 14 Leyden jars, communicate an intense incandescence to air, and light enough is produced to permit of the use of a narrow slit with large dispersion, and of a collimator and telescope of long focus.

Since 1877, when the first publication of the discovery of oxygen in the sun was made, still further improvements, especially in the optical parts, have been completed, so that I am now enabled to photograph the oxygen spectrum with four times the dispersion then employed. The Gramme machine is driven by a petroleum engine of one and a half horse-power, which gives a very constant current. One of the most important improvements in the research was in the use of a spark-compressor, to condense the spark between the poles. Under ordinary circumstances the spark follows a zig-zag course. I at first made use of two plates of glass, compressing the spark into a narrow space directed towards the slit; but I have since employed a soapstone compressor, with a narrow chink in it directed towards the slit. The lines seen in the spectroscope are thus greatly increased in brightness, and the intensity of the spectrum is much more nearly constant, owing to the fact that all the discharges take place directly in front of the slit. With such a spark-compressor I

have been able to make use of two bisulphide of carbon prisms of 2-in. aperture, and an observing or photographing lens of 6-ft. 6-in. focal length, and although the total light of the spark in air is not greater than a single candle, I have succeeded in obtaining photographs of the spectrum on a scale of 8-in. from G to H, that is about half the size of Angstrom's chart in the "Spectre Normal du Soleil." By comparison I have found that when the same current is used for volatilizing iron the light is 60 times stronger than the most vivid incandescence of air that I have produced. The slit of the spectroscope is about one inch long, and opposite the lower half is placed a right-angled prism, which serves to throw on the plate a solar spectrum derived from a beam of light received from a heliostat, and we can ascertain by observing with a magnifier, just previous to exposure, whether the adjustments are in the best order.

It is not commonly known that to obtain the last degree of exactness in coincidence, between a solar and an air spectrum, many precautions are necessary, and that is the reason it is desirable to have iron vapour present at one of the poles, so as to determine the reliability of the coincidence by comparing iron in the spark with the iron lines in the solar spectrum.

The first photographs taken were on so small a scale that they did not even give rise to a suspicion of the presence of oxygen in the sun, and it was not until 1876 that I felt sufficiently sure to make any publication. At this time the original negatives were about two inches long from G. to H., and they bore an enlargement of three or four times quite well. It was from these that the Albertype printed in 1877 was made. Since that time in order to meet the criticism that perhaps the dispersion was not sufficient to disclose the lack of coincidence, if such existed, I have increased the dispersion four times, and am thus enabled to make enlarged photographs on a scale about twice the size of Angstrom's chart. An enlargement never does justice to the original, and in order to study the coincidences satisfactorily the negatives should be examined with a magnifier. It should be noted that owing partly to the fact that the solar spectrum has suffered absorptive influences both in the earth's atmosphere and in the solar atmosphere, the conditions under which the oxygen spectrum is seen when compared with the spark spectrum are modified. In fact a critical study of the two spectra demands that each line of the spectrum should be separately photographed with the corresponding region of the sun's spectrum, so as to produce as nearly as possible the same conditions for each. As an instance of the modifications which may be caused by the solar atmosphere, the superposition of absorption lines on the

bright lines of oxygen may be mentioned. If, as seems to be the case, the stratum giving the oxygen spectrum lies deeper than the reversing layer in which iron exists, I see no reason why an iron absorption line, for instance, may not fall upon an oxygen bright band. In support of this proposition it should be stated that none of the oxygen bright lines have yet been recognized in the chromosphere. Even under the favourable circumstances enjoyed at Sherman, Prof. Young informs me that he did not detect in the chromosphere any of the bright lines of the group near G.

For the purpose of continuing this study, and also of examining small areas on the sun, faculæ spots, &c., Alvan-Clark & Sons are constructing a special spectroscope for me, which can give the dispersion of twenty heavy flint prisms, and can bear high magnifying power. In closing it may be well to give some idea of the amount of labour and time that this research has already consumed. Each photograph demands an exposure of fifteen minutes, and with preparation and development at least half an hour is needed. The making of a photograph, exclusive of intermediate trials, requires therefore about 30,000 ten-inch sparks—that is 30,000 revolutions of the bobbin of the Gramme machine. In the last three years the Gramme has made twenty millions of revolutions. The petroleum engine only consumes a couple of drops of oil at each stroke, and yet it has used about 150 gallons. Each drop of oil produces two or three ten-inch sparks. It must also be borne in mind that comparison spectra can only be made when the sun is shining, and clouds, therefore, are a fertile source of loss of time. (Applause.)

Dr. Draper then showed some exquisitely sharp negatives of the solar and oxygen spectra, which he had obtained, and handed round some paper enlargements, some 2ft. long, for inspection by the meeting.

Mr. Ranyard: After the reception that has been given to Dr. Draper, I do not think I need say anything about the importance of the research he has undertaken. When a couple of years ago he sent over copies from his former photographs on a much smaller scale, I then ventured to say that I thought the probability of the proposition which he laid down was very great indeed, amounting to some thousands to one, and I should like now to point out how enormously the probability has been increased by these more recent experiments. If Dr. Draper has increased his dispersion four times he has not merely increased the probability of his case four times, but he has increased the value of every coincidence he shows four times. On looking at the original photographs (which show the coincidences more

sharply than the paper prints) I counted eighteen oxygen lines, and, therefore, the increase of probability on the present occasion, as compared with the former occasion, is as four to the power of eighteen to one, a very enormous number. There are two or three ways of looking at the probability of the proposition which Dr. Draper has laid down, that the bright lines of oxygen coincide with the bright lines in the solar spectrum. In the first place, there is the chance that the centre of no single line of oxygen should fall opposite to a dark line or space in the solar spectrum. If a line were thrown at random beside the solar spectrum the chance that it should fall opposite to a bright part of the solar spectrum would be as the total breadth of the bright part of the solar spectrum to the total breadth of the dark part of the solar spectrum. Let us suppose that the breadth occupied by dark lines in the solar spectrum is equal to the breadth occupied by bright lines (probably as seen with high dispersion this is well within the truth) then the chance of any oxygen line falling opposite to a bright line or interspace in the solar spectrum would be one-half, and if the eighteen lines of oxygen had been thrown down at random beside the solar spectrum, the chance that the centre of all the lines should fall opposite to bright spaces would be one divided by two to the power of eighteen. In addition to this we must take into account the chances of the centres of the bright lines appearing to coincide with the centres of the bright interspaces where they do coincide, for in some instances the interspaces are double the breadth of the corresponding oxygen line, the oxygen line being on one side and coinciding with one edge of the interspace; but this is accounted for by the fact that there are probably other bright lines in the solar spectrum besides oxygen lines, and two such bright lines happen, in some instances to fall together. Then, also, it must be remembered that the light of the bright lines of the solar spectrum has suffered absorption in the solar atmosphere, and in the earth's atmosphere, so that they may be modified by the superposition of absorption lines. The observations of the bright lines seen at the limb of the sun renders it probable that the layer of the solar atmosphere, which gives rise to the dark lines, lies above the layer from which we receive the light of the bright oxygen spectrum, for no bright oxygen lines are seen in the chromosphere. So that it is possible to conceive that the oxygen lines of the solar spectrum may be modified as we observe them by the superposition of dark lines, and this appears in one or two instances to have been the case; but the character of the bright interspaces is very little changed. If, after examining the photographs, anybody has still any doubts as to the case made out by

Dr. Draper, I think that he will feel obliged to them if they will state their objections, and give him an opportunity of discussing them. (Applause.)

Mr. Christie: I do not feel exactly competent to enter on this question very deeply, but Dr. Draper has very kindly given me an opportunity of examining his very beautiful photographs, and I cannot help expressing my great admiration at the splendid results he has achieved. (Applause.) He has obtained photographs of the spectrum of oxygen which, as far as my rather limited acquaintance with the subject goes, are far superior to anything else of the kind; but that is quite another question from proving the existence of oxygen in the sun. I am afraid that is a very difficult question he has undertaken. If he could prove it, I think these photographs would go a very long way. I do not see myself that there is, as he has expressed it, very much more to be done in the matter. But I am sorry to say it seems to open up to me rather a hopeless prospect, because we are brought face to face with a great difficulty. Dr. Draper was very kind in explaining to me his views, and he did not at all shirk the difficulties of the case. I hope I may be justified in alluding to them, simply for the sake of getting at the truth. According to Dr. Draper's supposition the solar spectrum is made up of a continuous spectrum with dark absorption lines, and also bright lines superposed upon it. Now, the ordinary spectrum, which up to the present time we have supposed that we had to deal with, was a continuous spectrum with dark lines, but when you superpose on this bright lines, so faint that you cannot distinguish their brighness from the general background of the spectrum, it is evident that the problem becomes more complicated. I do not want to express any opinion one way or the other. I am in the position of a sceptic; it may be an unfortunate position, but I think it is a truly scientific position. Now, taking the position of a sceptic, one has to examine these photographs and look to whether Dr. Draper has shown the coincidences as Mr. Ranyard asserts; if not, his probabilities fall to the ground. In more than one instance I find an oxygen line opposite a broader bright space in the solar spectrum, which appears of identically the same brightness in its whole breadth. If the broader space consists of two or more bright lines, as has been suggested, we have two difficulties to contend with; in the first place we have to show that there are other substances which would give lines corresponding to the unoccupied breadth of the interspace, and in the second place we have the fact that these lines are undistinguishable in brightness from the oxygen lines. Again, each of the oxygen lines is fuzzy at the edges, and as there is nothing analogous in

the solar spectrum, we have to suppose that the fuzzy edges are cut off by adjacent dark lines. Now, if we are to make use of probabilities (laughter), I would ask what is the probability of a pair of dark lines falling in every case exactly at the edges of an oxygen line? We must also take into account the fact that former physicists have failed to identify any of the bright lines of oxygen with dark lines in the solar spectrum, and therefore we start with the fact that none of the oxygen lines can fall opposite to dark lines (applause).

Mr. Proctor said: There are one or two points I should like to mention. I do not think that Mr. Christie has sufficiently taken into account the importance of the fact that all the oxygen lines fall entirely opposite to bright interspaces in the solar spectrum, and that none of them even partially overlap dark lines. With regard to the general character of the solar spectrum, I would like to ask those who have more especially studied the subject, whether it does not seem probable from antecedent considerations that the solar spectrum should be purely gaseous in its character, that is to say, that there should be bright and dark lines, but no continuous background of spectrum. Perhaps some of you have considered the bearing of Mr. Croll's researches on this matter. He considers that the earth affords evidence that the solar system has been in existence for more than 20,000,000 of years, whereas, if the sun has been giving out energy as at present for 20,000,000 years, we know that it cannot have derived it from shrinking from even an infinite volume to a globe as large as the photosphere. I am not inclined to agree with him in his explanation that the solar energy may in part have been derived from the impact of stars, but rather think that it points to the fact that the real mass of the sun lies very much within the photosphere, and that if there is any solid or liquid nucleus, it is only at a depth of many thousands of miles below the photosphere. If that is the case, I would ask whether it is antecedently probable that there should be any continuous background in the solar spectrum. If the photosphere is purely gaseous, we should only have bright bands interfered with and modified by absorption lines (applause).

Dr. Gladstone: I have listened with the greatest attention to Dr. Draper. When the photographs first came over I was not convinced, but certainly he has produced results, which, as Mr. Ranyard has shown, have largely increased the evidence of there being real coincidences between the oxygen lines and bright spaces in the solar spectrum. There seems to be still a great question as to whether the solar spectrum is made up only of bright and dark lines, or whether there is a background of

continuous spectrum. I am not disposed to give up the idea that we have a continuous spectrum underlying these dark lines, but think that it is certain that we have also bright lines mixed with the dark. We know that when we look at the edge of the sun there are bright lines corresponding to hydrogen, and some other elements to be seen, but there are no oxygen lines. Now, I would suggest that this shows that the oxygen never rises to the level of the chromosphere, so as to be seen at the limb of the sun, and probably that is just the reason why we see its lines as bright lines and not as dark lines, for it never gets up to a level where it is sufficiently cool to form dark lines. We can easily understand that, with so much iron and magnesium vapour, all the oxygen as it rushes upwards to the higher levels may enter into combination and fall in a rain of oxides.

Dr. Huggins said that he had examined Dr. Draper's photographs, and was overwhelmed with a sense of the large amount of conscientious labour and care which he had evidently bestowed upon the investigation (applause). Dr. Draper had made out a *primâ facie* case, which entitled him to demand a careful examination of the evidence he had brought forward; but for his own part he should like to suspend his judgment until he had had an opportunity to re-examine that part of the spectrum. He preferred to wait for a little light, a little sunlight, on the subject, but he wished now to state how thoroughly impressed he was with the cautious and careful experimental arrangements which Dr. Draper had adopted (applause).

Capt. Noble: It seems to me, looking at the photographs impartially, that if we are to deny the evidence supplied by some of these coincidences, and notably by this group of four lines, and accept Mr. Christie's dicta, we literally should have no tangible evidence as to the existence of any element in the sun at all. (Laughter.)

Mr. Ranyard: I should like to refer to one or two of the objections raised by Mr. Christie. I understood him to urge as an objection that there are a great many bright spaces which have not been matched with the bright lines of non-metallic elements. But I would remind him that there are also many dark lines which have not been matched with the lines of known elements. Perhaps they will never be matched, for the conditions in the sun may not correspond to the conditions obtainable in our laboratories. With regard to the bright lines falling opposite interspaces which are broader than the bright lines of oxygen, the probability is, as Mr. Christie states, very great against their being two adjacent bright lines of exactly equal brightness, but it must be remembered that we are not examining the bright lines themselves, but

only photographs of the lines, and that the bright parts of these photographs are what would be called by photographers over-exposed, and, consequently, the gradations of brightness are very much obliterated. Again, I understood Mr. Christie to say that if, instead of matching oxygen lines with interspaces, you began the other way, you ought to find the brightest lines of the spectrum matching the oxygen lines, but this involves the assumption that oxygen gives brighter lines than any other element in the sun. But I would ask what reason we have for assuming that oxygen gives brighter lines than any other element? With regard to the probability of there being a continuous background of brightness in the solar spectrum, it should be remembered that there are theoretical considerations which render it probable that there is always such a continuous background more or less faint between the bright lines in the spectrum of a gas—when the pressure is considerable the brightness of the continuous part of the spectrum is conspicuous; but theoretically there will always be a continuous spectrum corresponding to the short interval of time after the impact of molecules during which the jar of the collision lasts. In the free path between the impacts they give out the characteristic wave lengths, but however rare the gas I suppose there will always be some continuous spectrum corresponding to the impacts, and with the spectra of a great many gaseous elements superposed the continuous spectrum may be conspicuous. We need not, therefore, assume if we should find evidence of such a continuous spectrum that there is any solid or liquid matter in the photosphere; and if it should turn out that there are no oxygen lines above the photosphere, it will not, I think, follow that there is no oxygen there, for there seems to be evidence that the spectrum of some of the elements changes materially at different altitudes, for example, the 1474 line is the brightest of the bright lines in the corona, but it is a very faint line at the level of the reversing layer, and D_3 is a very bright line in the lower chromosphere, but there is no dark line corresponding to it.

Mr. Christie: May I be allowed to make just a few remarks, especially as to what Mr. Ranyard has said?

Mr. Knobel: I rise to order to say that by the ordinary rules of debate it is customary for speakers only to speak once on a subject. Mr. Ranyard having infringed that rule I do not know how we shall go on.

Mr. Ranyard: It would, I think, be only fair to give Mr. Christie a hearing, in reply.

Mr. Christie: I should not have risen except that reference had been made to my remarks. I do not know that I should say

very much, but I think I may remark with reference to this question of coincidence, that everything turns upon the exactness of the coincidence, and whether these are actually coincidences or not. I am not quite prepared to admit that these coincidences are perfect; in fact, I should say there are even coincidences of dark lines with some of the oxygen lines. I admit that it is a matter of judgment, and I should be sorry to say positively that there are such coincidences with dark lines. But there is considerable uncertainty in the matter. As Dr. Draper has explained there is a great difficulty in establishing coincidences, and you have to adjust your apparatus until you match coincidences by the known lines of iron. It seems some of these do not coincide exactly with the dark lines in the sun. I only alluded to that as being one of the difficulties we have to contend with. With regard to Mr. Ranyard's remarks as to the eye perceiving differences of brightness which the photographs do not show, I would merely wish to ask whether he has examined with his eye different parts of the spectrum, for there is a certain part in the neighbourhood of the G lines which I have examined and find the photograph gives exactly the same appearance as is seen with the eye, *i.e.*, the whole space is of equal intensity. I do not think there is much difference between the photograph and the spectrum as seen with the eye. The only object of my remarks was to clear the ground and to point out what it is we are assuming when we predicate the existence of oxygen as giving bright lines in the sun. I do not dispute it, but only point out the difficulties we must face in order that they may be fairly met. (Applause.)

Mr. J. Rand Capron: There is one question I should like to ask Dr. Draper, and that is, whether he had tried any experiments with the tube spectrum of oxygen?

Dr. Draper: A great many.

Mr. J. Rand Capron: The spark taken in air would probably hardly agree with the spectrum of oxygen near the sun's body. I have had occasion to photograph simultaneously the tube spectrum of hydrogen and the air spark spectrum at ordinary pressures. The tube spectrum of hydrogen showed four hydrogen lines perfect throughout, but only one of these lines was represented in the spectrum of air at ordinary pressure, so that it is possible certain oxygen lines present in the sun may be absent in the spark spectrum.

Dr. Draper: I have taken the oxygen spectrum under a great many different circumstances. I began with tubes containing oxygen and compounds of oxygen, but the difficulty is that you are limited to rather small dispersion, because you cannot get

brightness enough for a larger apparatus. Then the difficulty of having iron terminals so as to show a good coincidence is a serious one. So when I made the spark-compressor I arranged a contrivance at the back which would enable me to let in oxygen and the other gases between the terminals, and after various experiments with oxygen I find that it seems to suffer less change with altered conditions than a great many of the other elements I have experimented on. I have fairly shown that the bright lines coincide with bright spaces in the solar spectrum. The minor differences may be fairly attributed to such changes of condition as Mr. Rand-Capron has referred to. With regard to Dr. Gladstone's remark, which was that probably we should not find in the chromosphere the lines of the oxygen spectrum. That is precisely what I hope will be the case, although I am going to look as hard as I can for them. I should like to see them if they are there, but I shall be better satisfied if they are not. (Laughter and applause.)

A cordial vote of thanks was then passed to Dr. Draper.

Mr. R. C. Johnson read his paper *On a new method of controlling the driving clock of an equatorial.* He said: This is a control by brake applied by means of electro-magnetism whenever the normal velocity of the driving clock is exceeded.

When the arms of the governor, carrying the centrifugal balls, spread out too widely by increase of velocity, they establish electric contact by a simple piece of additional mechanism by which a slight break is instantly put on the axis carrying these arms.

The velocity is checked, the arms drop, and the contact being broken the break is removed. This goes on rapidly, and keeps the clock to a uniform speed even when the driving weight is greatly increased. I have added 22 lbs. to a 40 lb. driving weight without affecting the rate. Four to eight Lé clanchè cells are necessary to supply the current.

This has been in use for three months at my observatory at Higher Bebington.

Mr. Redhouse read a paper *On ancient observations of the zodiacal light.*

The following papers were also laid on the table and partly read:

J. Tebbutt: *Observations of Brorsen's comet February and March,* 1879.

H. C. Russell: *An important invention, giving perfectly uniform rotary motion in driving clocks.*

Dr. T. Oppolzer: *Determination of the longitudes of Berlin, Munich, Leipzig, Vienna, Paris, and Pulkowa.*

C. Carpmael: *On the values of the constants in the equation,* ${}_rA_r\,x\,({}^r) + {}_rA_{r-1}\,x\,({}^{r-1}) + \ldots + {}_rA_t\,x\,({}^t) + \ldots + {}_rA_0 - y_x = 0$; *obtained by the method of least squares from the* $n + 1$ *values of* y_x *when* $x = 0\ 1, 2, \ldots n$; n *being greater than* r.

D. Gill: *On the value of the solar parallax derived from observations of Mars made at Ascension Island during the opposition of* 1877.

G. M. Seabroke: *Spectroscopic observations of the motion of the stars in the line of sight, made at the Temple Observatory, Rugby.*

E. J. Stone: *Note on the Cape catalogue of* 12450 *stars* (extract from a letter to the Astronomer-Royal).

R. H. M. Bosanquet and Prof. A. H. Sayce: *Preliminary note on the Babylonian astronomy; The Babylonian calendar.*

Prof. H. Draper: *On the coincidence of the bright lines of the oxygen spectrum with bright lines in the solar spectrum.*

A. M. W. Downing: *On the applicability of the mean refractions of Bessel's Fundamenta to the Washington observations.*

Prof. C. Pritchard: *Note on the photographic semi-diameter of the moon.*

A. Marth: *Note on the transit of the earth and moon across the sun's disk, as seen from Mars on November* 12, 1879, *and on some kindred phenomena.*

Rev. J. Pearson: *On a new method of mounting an equatorial.*

The meeting adjourned at a quarter past ten o'clock.

NOTE.—In order to make the report of the discussion on Mr. Sadler's paper in our last intelligible to those who have not access to the Society's publications, we append a summary of the paper in question, an account of which was accidently omitted in our February number. Mr. Sadler states that what he considers the cautious language used by the Astronomer-Royal in presenting the Gold Medal of the Society to Admiral Smyth for his *Cycle of Celestial Objects*, has been justified by the results. In support of his assertion he states that of 108 measures in the first hour of R.A., 32 have a weight of only 1 attached to them. He proceeds to quote Mr. Burnham's opinion, published in the *English Mechanic*, that "no publication of original observations, in this or any other language, can be named which contains so many serious errors." Mr. Sadler states that on comparing the work (corrected by means of the "Corrigenda" slip) with the original MS., he found "the most extraordinary discrepancies." This catalogue, he says, is surpassed in inaccuracy only by the *Reference Catalogue of Multiple and Double Stars*, forming Vol. XL. of the Society's Memoirs. A list is then given of some 40 objects and

their distances and position-angles, as recorded in the *Cycle*, compared with those given by other observers. In some of the notes attached to these observations, Mr. Sadler intimates that Smyth copied from others, and sometimes assigned distances, &c., to objects that he had not observed—more than this, that he has not always copied correctly.

REVIEWS.

Etoiles doubles. Groupes de perspective certains. Par M. Flammarion.

The comparison of all the micrometric measurements of double stars, supplemented by new measurements, proves that all the following pairs are merely optical groups due to the meeting on the same visual ray of stars situated the one beyond the other in space, and having different proper motions. . . . Many of these optical groups present considerable angular distances; some on the contrary are very close. Some will be remarked whose components are of the same brightness, which shows that stars of the same apparent magnitude may be at very different distances from us, Some also will be remarked whose colours present real contrasts, which shows that there are blue or green isolated stars. A few of these pairs have been observed more than a century, such as *o* Ceti since 1683, an optical companion of Procyon since 1692, ζ Leonis since 1755, &c. I have determined the elements of the movement of the companion of each star, by calculating its mean direction (reckoned from the north) and its annual velocity, from the whole of the observations. (Some groups have not been recently measured, either by myself or those astronomers who have kindly offered me their services for such important measurements: I have placed the last measurement in parentheses; but it has not been possible to calculate the movement, although these groups are themselves also certainly optical)."

This valuable paper of M. Flammarion contains particulars of 135 stars; specimens of which we give abridged from the original catalogue:—

Name.	Magnitudes.	Colours.	Actual angle.	Actual distance.	Direction of movement.	Annual velocity.
				″		″
ψ Cassiopeiæ	A B 4, 0—9, 5	yellow and bluish	105	29	246	0,07
						B double.
o Ceti	Var. —9, 5	red and bluish	82	118	14	0,34
7 Tauri	A C 7, 0—10	white and blue	60	82	320	0,05
Aldebaran	1, 6—11	orange and blue	35, 2	114	26(1)	0,15
Procyon	A E 1, 4—11	A white	314	41	41	1,21
	A F 1, 4—8, 0		80	346		
	A G 1, 4—8, 5		286	371(2)		
Pollux	A B 2, 0—11	A yellow	72	175	85	0,66
	A C 2, 0—12, 5		90	205		
	A D 2, 0—10		75	299(3)		
61 Virginis	4, 5—10, 5	A white	22, 6	169	47	1,48
σ Coronæ B.	A C 6, 0—13	yellow and bluish	222	16	86	0,26
	A D 6, 0—10		88	54	two comp. opt.	
Vega	1, 0—8, 8	A bluish	155	48	216(4)	0,34
Altair	1, 5—10	A white	312	156	235	0,67
β Delphini	A D 4, 0—10, 5	A green	335	35	275(5)	0,12
85 Pegasi	6, 0—9	A white	34	14(6)		

(1) According to my observations, the small star is not fixed, as in that case, its position, starting from 1836, ought to be 32°,5 and 112″.

(2) These three companions are optical. The nearer companion which M. Otto Struve announced to have observed in 1873, and followed during two years, does not exist.

(3) The star C, which had not been measured before my observation, completes this optical group.

(4) The other companions of Vega appear to have no real existence. The proper motion of this brilliant star seems to be decreasing.

(5) Quadruple.

(6) This star is the last which I have measured at the observatory. My observations having been suspended, I have asked Mr. Burnham, of Chicago, to continue these measurements. He has discovered a new companion to this star, which it will be very interesting to follow on account of the great proper motion of the principal star.

Observations and Orbits of the Satellites of Mars, with data for Ephemerides in 1879. By Asaph Hall, Professor of Mathematics, U.S., Superintendent of the Naval Observatory, Washington. 1878. pp. 46.

When in the spring of 1877 the approaching favourable opposition of Mars led Prof. Hall to think of searching for a satellite with the large Clark refractor, an examination of the literature of the planet showed such a mass of observations by skilful astronomers, that he had well-nigh given up the idea had it not been for the encouragement of his wife. Sir William Herschel had in vain searched for satellites in 1783; and the diligent search of D'Arrest, formerly director of the observatory of Copenhagen, either in 1862 or 1864 (it seems rather doubtful which) was equally fruitless. Still, the power and excellence of his glass made Prof. Hall feel that there was a little hope left, though the chances, owing to the southern declination of the planet, seemed to be in favour of the powerful reflector at Melbourne.

Early in August the search was began. Faint objects seen at some distance from the planet proving to be fixed stars, the examination was commenced on the 10th of the region close to the planet, and enveloped in its glare of light. This was done by sliding the eye-piece so as to keep the planet just outside the field of view, and then turning it in order to pass completely around the planet. Nothing was found, by reason that the satellites were then near the planet, whose image was very blazing and unsteady. Prof. Hall says: "The sweep around the planet was repeated several times on the night of the 11th, and at half-past two o'clock I found a faint object on the following side, and a little north of the planet, which afterwards proved to be the outer satellite. I had hardly time to secure an observation of its position, when fog from the Potomac river stopped the work. Cloudy weather intervened for several days. On the night of August 15, the sky cleared up at eleven o'clock, and the search was resumed, but the atmosphere was in a very bad condition, and nothing was seen of the object, which we now know was at that time so near the planet as to be invisible. On August 16 the object was found again, on the following side of the planet, and the observations of that night showed that it was moving with the planet, and, if a satellite, was near one of its elongations. On August 17, while waiting and watching for the outer satellite, I discovered the inner one. The observations of the 17th and 18th put beyond doubt the character of these objects, and the discovery was publically announced by Admiral Rodgers. Still, for several days the inner moon was a puzzle. It would appear on different

sides of the planet in the same night, and at first I thought there were two or three inner moons, since it seemed to me at that time very improbable that a satellite should revolve around its primary in less time than that in which the primary rotates. To decide this point I watched this moon throughout the nights of August 20 and 21 and saw that there was in fact but one inner moon, which made its revolution around the primary in less than one-third the time of the primary's rotation, a case unique in our solar system"

When we think of the bad taste displayed in the naming of some of the minor planets, we rejoice that Prof. Hall adapted names for these moons suggested by Mr. Madan, of Eton, which are Deimos (Terror) for the outer satellite, and Phobos (Fear) for the inner satellite. These are mentioned in Homer as the sons of Ares (Mars). Eris (Strife) sister of the war god (also in Homer) would have served well for a third name if it had been wanted. Prof. Hall continues: "The Washington observations of Deimos extend from August 11 until October 31, and those of Phobos from August 17 until October 15. Both satellites were observed at Harvard College Observatory by Mr. Leonard Waldo, with the 15-inch Munich refractor; and a good series of observations of both these faint moons was made by Mr. Henry S. Pritchett, at Glasgow, Missouri, with the 12¼-inch Clark refractor of the Morrison Observatory. Observations of Deimos were made at several observatories in Europe; Pulkova, Greenwich, Oxford, and Paris; and at the private observatories of Mr. Common in England, and Mr. Erck in Ireland. But, so far as I know, Phobos, the inner moon, which is the brighter one, but more difficult to observe, on account of its proximity to the planet, was not observed in Europe, except at Greenwich and Oxford. As this moon was observed by Mr. Pritchett very near the limb of the planet with a 12¼-inch Clark glass, and was seen on several nights by Dr. Draper and Professor Holden with the 12-inch Clark glass belonging to Dr. Draper, I think the observers in Europe failed to find this moon because they did not keep up a careful and persistent search for it. Its motion is very rapid, and for a considerable part of the time it was hid by the planet. It is so close to the planet that it is a difficult object, but that it is brighter than Deimos is shown by the fact that it could be followed and observed much nearer the limb of the planet. The northern position of the European observatories would increase the difficulty of finding such faint objects, and perhaps also the inferior definition of some of the European telescopes is another reason why observers there failed to find this inner moon."

We think Prof. Hall was wise in using the series of observations at Washington alone, as much more complete than any other, for computing the orbits of the satellites. The other observations, however, have also been turned to account. The eye-piece used was an achromatic one of 400 magnifying power. Excepting three observations of Deimos made by Professors Newcomb, Harkness and Holden, all the observations were made by Prof. Hall himself, who expresses his thanks for the assistance of his colleagues at the naval observatory. "I am indebted," he says, "to Professor Newcomb and Mr. D. P. Todd for assistance in the absence of Professor Holden. Mr. Todd worked with me throughout the nights of August 18 and 19. But above all am I indebted to Mr. George Anderson, assistant on the large refractor, for his zealous and faithful assistance. On eight successive nights, from August 15 to August 23, we were at the observatory, and on most of these nights our work extended from nine o'clock until morning." . . "The unfavourable weather during the month of October, prevented many observations of the satellites. On November 7 and 12 they were looked for but could not be seen,

and after the 20th November the search was given up." . . "Since these satellites are always seen inside the glare of light that surrounds the planet, an estimate of their magnitude is difficult."

Prof. Hall observes that "the methods given by Gauss in his *Theoria Motus*, are theoretically sufficient for computing the orbit of a satellite; but in this case we have such relations that a small error of observation may so vitiate our result that it will not be even an approximation to the truth. A better way is first to assume the orbit to be a circle, to determine the node and inclination, which fix the position of the orbit plane, and then by comparison of the observations with the circular elements to correct them, either by graphical methods, or, if the eccentricity be small, by means of the equations of condition." Tables and formulæ belonging to these computations are given, and having thus first obtained approximate circular elements, the co-efficients of the equations of condition were computed by Dr. C. Powalky, and the computations checked by Prof. Hall. The equations were then multiplied by the square roots of the weights, and solved by the method of least squares. The corrections having been applied to the assumed elements, the corrected elements were found as follows, where μ is the daily motion, a the mean distance, J inclination of plane of the orbit to the plane of the equator, N, R.A. of ascending node on the equator, ω distance of perihelion from node, e eccentricity, u angular distance of satellite from the node at the epoch.

DEIMOS.

Epoch = 1877, Aug. 28·0, Greenwich Mean Time.
Period = 1d.·262429 = 30h. 17m. 53·86s. ± 8·985s.
Log. μ = 2·4550955.
a = 32″·3541 ± 0″·0118.
J = 35° 38′·7 } Equator, Aug. 28th,
N = 48° 5′·7 } 1877.
ω = 40° 53′·6 ± 5° 4′·98.
e = 0·005741 ± 0·0004898.
u = 357° 30′·5.

PHOBOS.

Epoch = 1877, Aug. 28·0, Greenwich Mean Time.
Period = od.·3189244 = 7h. 39m. 15·07s. ± 1·123s.
Log. μ = 3·0526147.
a = 12″·9531 ± 0″·0142.
J = 36° 47′·1 } Equator, Aug. 28th,
N = 47° 13′·2 } 1877.
ω = 45° 30′·4 ± 2° 11′·16.
e = 0·032079 ± 0·001407.
u = 285° 20′·2.

The planes of the orbits of both satellites are very nearly coincident with the equator of Mars. The elements of these orbits are determined with tolerable accuracy, excepting the periodic times, for an accurate determination of which we must wait until another opposition. . . In the orbit of Deimos, the eccentricity being small, the position of the line of apsides is of course uncertain, and circular elements suffice for the observations. Expressing the mass of the planet in the common unit, the above elements give the following results:

Deimos: mass of Mars = $\frac{1}{3095313 \pm 3485}$

Phobos: " " = $\frac{1}{3078456 \pm 10104}$

And the mean by weights as the final result from the Washington observations is:

$$\text{Mass of Mars} = \frac{1}{3093500 \pm 3295}$$

Prof. Hall proceeds to compare the observations at the observatories of Cambridge and Glasgow, U.S., and those made at the European observatories, with the elements found from the Washington observations. After discussing Mr. W. Erck's observations, he says, "We may therefore consider as established the curious fact that while this satellite [the outer one] was not seen with the great Melbourne reflector at a zenith distance of only 25°, it was seen by Mr. Erck with a Clark refractor of 7½ inches aperture at a zenith distance of 66°." The value of the mass of Mars has been changed frequently since the time of Laplace, this change showing a gradual diminution in the value. In conclusion, Prof. Hall, considering the great advantages of the 26-inch refractor in observations of such objects, adopts the value of the mass, as given above, the mean of the Washington observations alone.

"The hourly areocentric motion of Phobos is 47°·033; and on account of its rapid motion, and its nearness to the planet, this satellite will present a very singular appearance to an observer on Mars. It will rise in the west and set in the east, and will meet and pass the outer moon, whose hourly motion is only 11°·882. The distances of these satellites from the centre of the planet are: for Deimos 14,500 miles, and for Phobos 5,800 miles. The semi-diameter of the planet being 2,100 miles; the horizontal parallaxes of these satellites are very large, amounting to 21° for Phobos. The nearness of this satellite to the surface of the planet will produce apparent eccentricities in its motion, and cause it to appear as a variable star." The size of the satellites is not well known, and perhaps the only thing we can say in this respect is the indefinite statement that they are very small.

VARIABLE STARS, JULY.

Approximate times of minima and maxima, according to Schönfeld and Winnecke.

1879.	G.M.T. h.			mag.	R.A. h.	m.	s.	1855. Decl. °	′
July 1		T Herculis	max.	8	18	3	37	+ 30	59·9
2		S Sagittæ	min.	10	20	7	27	+ 16	17·4
6	11·9	U Coronæ	min.	9	15	12	17	+ 32	10·8
7	8·8	δ Libræ	min.	6	14	53	14	— 7	56·1
10		R Bootis	min.	7	14	30	48	+ 27	22·1
11		S Scorpii	max.	9	16	9	2	— 22	31·9
12		R Herculis	max.	7·8	15	59	43	+ 18	45·9
13	9·5	U Coronæ	min.	9	15	12	17	+ 32	10·8
14	8·4	δ Libræ	min.	6					
16		S Vulpeculæ	min.	9·5	19	42	27	+ 26	55·7
21	8·0	δ Libræ	min.	6					
22		U Virginis	max.	8	12	43	45	+ 6	20·6

ASTRONOMICAL OCCURRENCES FOR JULY, 1879.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Tues	1		Sidereal Time at Mean Noon 6h. 36m. 40·30s.	3rd Ec. R.	13 18 35	Vega.
				3rd Oc. D.	14 38	11 54·2
Wed	2		Sun's Meridian Passage 3m. 41·57s. after Mean Noon			11 50·3
		9 37	○ Full Moon			
Thur	3	10 30	Occultation of B.A.C. 6490 (6½)	2nd Sh. I.	14 14	11 46·4
		11 43	Reappearance of ditto			
		12 9	Occultation of B.A.C. 6889 (6)			
Fri	4	12 42	Reappearance of ditto			11 42·5
				1st Sh. I.	13 50	
Sat	5			2nd Oc. R.	14 24	11 38·5
				1st Tr. I.	15 1	
Sun	6	10 4	Near approach of λ Capricorni (5½)	1st Ec. D.	11 1 59	11 34·6
				1st Oc. R.	14 30	
Mon	7	12	Saturn at quadrature with the Sun	1st Sh. E.	10 38	11 30·7
				1st Tr. E.	12 47	
Tues	8	3	Conjunction of Moon and Jupiter 5° 42′ S.			11 26·7
Wed	9					11 22·8
		20 54	☾ Moon's Last Quarter			
Thur	10	21	Conjunction of Moon and Saturn 8° 20′ S.			11 18·8
		11 23	Occultation reappearance of 101 Piscium (6)			
Fri	11	11	Conjunction of Moon and Venus 8° 20′ S.			11 14·9
				3rd Tr. E.	11 43	
Sat	12	15 22	Near approach of 26 Arietis (6)	2nd Ec. D	11 48 21	11 10·9
				1st Sh. I.	15 43	
Sun	13			1st Ec. D.	12 56 15	11 7·0
				1st Sh. I.	10 11	
				2nd Tr. E.	11 8	
Mon	14	12 16	Occultation reappearance of 36 Tauri (6)	1st Tr. E.	11 16	11 3·1
				1st Sh. E.	12 31	
				1st Tr. E.	13 35	
			Illuminated portion of disc of Venus=0·493			
Tues	15		Illuminated portion of disc of Mars=0·839	1st Oc. R.	10 45	10 57·2
Wed	16		Sidereal Time at Mean Noon 7h. 35m. 48·67s.			10 53·2
Thur	17		Sun's Meridian Passage 5m. 50·86s. after Mean Noon			10 49·3

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Fri	18	21 5	● New Moon Eclipse of the Sun invisible at Greenwich			Vega. — 10 45·4
Sat	19		Saturn's Ring : Major axis=40″·74 Minor axis= 7″·40	3rd Sh. E. 3rd Tr. I. 2nd Ec. D. 3rd Tr. E.	11 24 11 47 14 22 54 15 16	10 41·4
Sun	20			1st Ec. D.	14 50 36	10 37·5
Mon	21	3 21	Conjunction of Moon and Mercury 2° 46′ N. Mars at quadrature with the Sun	2nd Tr. I. 2nd Sh. E. 1st Sh. I. 1st Tr. I. 2nd Tr. E. 1st Sh. E.	10 40 11 40 12 5 13 3 13 51 14 24	10 33·6
Tues	22	16	Conjunction of Moon and Venus 4° 8′ N.	1st Oc. R.	12 32	10 29·6
Wed	23			1st Tr. E.	9 48	10 25·7
Thur	24					10 21·8
Fri	25	22 35	☽ Moon's First Quarter	4th Sh. E. 4th Tr. I.	11 16 14 59	10 17·8
Sat	26			3rd Sh. I. 3rd Tri. I. 3rd Sh. E.	11 46 15 15 15 23	10 13·9
Sun	27					10 9·9
Mon	28	9 37	Occultation of α Scorpii ($1\frac{1}{2}$)	2nd Sh. I. 2nd Tr. I. 1st Sh. I. 2nd Sh. E. 1st Tr. I. 2nd Tr. E. 1st Sh. E.	11 24 13 1 14 0 14 17 14 48 15 52 16 19	10 6·0
Tues	29			1st Ec. D. 1st Oc. E.	11 13 44 14 18	10 2·1
Wed	30			1st Tr. I. 2nd Oc. R. 1st Sh. E. 1st Tr. E.	9 15 10 35 10 47 11 33	9 58·2
Thur	31	8 52 8 58	Occultation of B.A.C. 6699 ($6\frac{1}{2}$) Reappearance of ditto			9 54·2
AUG		13 6	Occultation of υ Capricorni ($5\frac{1}{2}$)			
Fri	1	14 16	Reappearance of ditto			9 50·3

THE PLANETS FOR JULY.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury...	1st	7 42 29	N.23 17½	5″·4	1 5·6
	9th	8 41 46	N.19 49	5″·9	1 33·3
	17th	9 28 54	N.15 26	6″·5	1 48·9
	25th	10 4 24	N.10 57	7″·5	1 52·8
Venus ...	1st	9 48 11	N.14 49½	20″·4	3 11·0
	9th	10 18 48	N.11 29	22″·2	3 10·0
	17th	10 47 4	N. 7 57½	24″·2	3 6·8
	25th	11 12 49	N. 4 22	26″·8	3 1·0
Mars ...	1st	1 3 4	N. 4 8	10″·6	12 23·4
	9th	1 22 51	N. 6 5	11″·0	18 11·7
	17th	1 42 12	N. 7 56	11″·4	17 59·5
	25th	2 1 0	N. 9 39	12″·0	17 46·8
Jupiter ...	1st	22 58 5	S. 7 52½	41″·3	16 18·7
	9th	22 57 47	S. 7 57	42″·5	15 47·0
	17th	22 56 20	S. 8 9	43″·5	15 14·5
	25th	22 54 54	S. 8 19½	44″·3	14 41·2
Saturn ...	1st	0 59 42	N. 3 46	15″·8	18 20·0
	9th	1 0 51	N. 3 51	16″·0	17 49·7
	17th	1 1 37	N. 3 53	16″·3	17 19·0
	25th	1 1 59	N. 3 53	16″·5	16 47·9

Mercury is visible for about an hour after sunset on the 1st, the interval increasing for a few days, and then decreasing to three-quarters of an hour on the last day.

Venus sets about two hours and a quarter after the sun at the beginning of the month, the interval decreasing.

Mars rises just before midnight on the 1st, the interval increasing.

Jupiter rises about an hour before midnight, at the beginning of the month, the interval increasing.

Saturn may be observed about midnight, and then earlier each night.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JULY, 1879.

BY W. R. BIRT, F.R.A.S., P.S.S.

WHITE SPOT WEST OF PICARD.—It is reported that this object, which has for several years past been under observation more or less, appeared as a distinct white spot *from which a dark shadow projected in the direction of the terminator*, which at the time, April 9, skirted the ridge west of Picard. So far as the writer is aware a shadow has not been noticed in connection with the white spot west of Picard. About nineteen years ago it was seen as an ill-defined white cloudy patch, larger than Picard; about seven to ten years later towards sunset on the *Mare Crisium* it presented the appearance of a pit-like marking of a beautiful whiteness; now (April 9, 1879) it is reported as "projecting a shadow towards the terminator" three days after the full moon. It is exceedingly important that the existence of this shadow should be confirmed by at least *one* independent observer, *i.e.*, an observer not connected in any way with the

observer who detected it. Of course, if seen again by the same observer it will amount to a confirmation to him of his former observation, but it will lack that weight of testimony which attaches to the observation of an object by two separate observers using different instruments. As the object appears to be well-known, perhaps our readers will give particular attention to it during the next two or three lunations.

STREAKS FROM PROCLUS.—Mr. Dennett gives in the *English Mechanic*, No. 721, January 17, 1879, a list of nine so-called streaks from Proclus, on page 473. Of these attention is directed this month to his streak No. 8. As a few observations have been made of this streak, perhaps a publication of a selection of them will best indicate the points that require further and careful observation.

1879. March 6, 9.30. The Rev. W. J. B. Richards recorded:—
"Peirce A is just visible to the north of the ray from Proclus.

„ March 8, 9.40. Peirce A quite gone. A ray from Proclus passes between it and Peirce. The ray seems brighter and denser on the south side, and Peirce A is just caught and hidden by the lighter northern side of it."

„ May 29, 10.30. Moon 23 hours past first quarter. Mr. T. P. Gray, of Bedford, wrote:—
"For the first time Peirce A was observed. I was able to trace the streak as on previous occasions to a point on the border of the dark aureole round Peirce A had it been visible, but neither it nor Peirce A were to be seen." The streak as seen by Mr. Gray ended in a slight curve, and was lost as it merged in the general surface of the *Mare*. Mr. Gray continued—The question is whether the curve which apparently terminates the streak is a ground marking or really a portion of the streak diverted from its course. It appears to be visible very soon after the first quarter, and is sufficiently dense to entirely obscure Peirce A, nor is this all, for the aspect of the district surrounding Peirce A is altered, the dark aureole being absent."
"I see by the Rev. W. J. B. Richards' observations, which you sent me, that Peirce A was observed on March 8 (full moon), I will try to obtain an observation at that age, and then we shall be better able to compare the two."

The observations above quoted testify to a change within small limits in the duration of this particular streak as it appears to pass *over* the *Mare Crisium*, also that, whatever it may be, it is capable of hiding to human eyes the crater Peirce A which is otherwise conspicuous. The fact that the streak has obscured the crater has been witnessed by three independent observers, viz., Birt, Richards, and Gray.

Water Lane, Stratford, E.:
June 19, 1879.

JUPITER.

1879. oh. Gr.	Angle of position of 4's axis.	Latitude of Earth above 4's equator.	Latitude of Sun above 4's equator.	Equat. diameter.	Greatest phase.
	°	°	°	″	′
July 4	335·30	+1·43	+0·92	44·18	0·35
14	335·32	1·48	0·96	45·50	0·28
24	335·38	+1·50	+1·01	46·72	0·21

The assumed First Meridian passes the middle of the illuminated disk at the following times:

1879.	G. M. T. h. m.		h. m.		h. m.
July 1	0 13·7	July 12	4 9·5	July 23	8 4·9
	10 9·1		14 4·9		18 0·3
	20 4·5	13	0 0·3	24	3 55·6
2	5 59·9		9 55·7		13 51·0
	15 55·3		19 51·1		23 46·4
3	1 50·7	14	5 46·4	25	9 41·8
	11 46·1		15 41·8		19 37·1
	21 41·5	15	1 37·2	26	5 32·5
4	7 36·9		11 32·6		15 27·9
	17 32·3		21 28·0	27	1 23·3
5	3 27·7	16	7 23·4		11 18·6
	13 23·1		17 18·8		21 14·0
	23 18·5	17	3 14·2	28	7 9·4
6	9 13·9		13 9·5		17 4·7
	19 9·3		23 4·9	29	3 0·1
7	5 4·7	18	9 0.3		12 55·5
	15 0·1		18 55·7		22 50·8
8	0 55·1	19	4 51·1	30	8 46·2
	10 50·9		14 46·5		18 41·6
	20 46·3	20	0 41·8	31	4 37·0
9	6 41·7		10 37·2		14 32·3
	16 37·1		20 32·6	Aug. 1	0 27·7
10	2 32·5	21	6 28·0		10 23·1
	12 17.9		16 23·4		20 18·4
	22 23·3	22	2 18·7		
11	8 18·7		12 14·1		A. M.
	18 14·1		22 9·5		

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Stothard, Dr.

To June, 1879.
Compton, A. J. S.

To Dec., 1879.
Banks, Mrs.

To July, 1880.
Thomas, J. H.

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The Astronomical Register.

No. 200. AUGUST. 1879.

STELLAR MAGNITUDES.

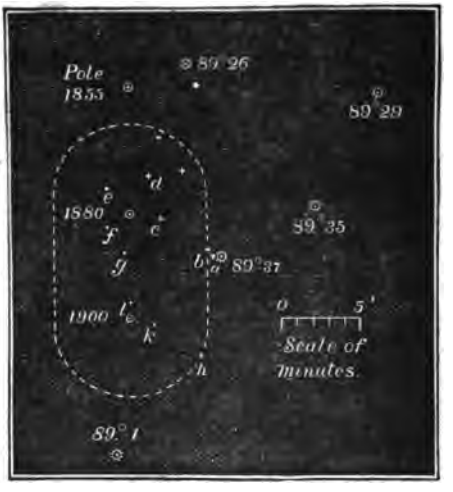
A Request to Astronomers.

The scales adopted by different observers in their estimates of stellar magnitudes differ considerably from each other, as is well known. As regards the brighter stars, these differences, indeed, are comparatively unimportant; but they become larger and more perplexing when the objects observed are faint. Variations of three or four magnitudes may be expected between the estimates made of the brightness of minute companions seen near a brilliant star. It is needless to point out the inconvenience of this state of affairs, which at times nearly deprives the estimated magnitudes, found in catalogues, of their meaning, and consequently of their value.

In the hope of providing a partial remedy for this defect, a series of Photometric Observations of Stars of various magnitudes, situated near the north pole, has been undertaken at the Harvard College Observatory. The region has been selected as one which may always be conveniently observed in the northern hemisphere, so that the brightness of a star observed in another part of the sky can readily be compared by estimate with any standard polar stars, the relative brightness of which may have been determined by photometric measurements.

The table and chart given below are designed to serve as guides in finding the stars which are, as has been said, in course of photometric measurement at the Harvard College Observatory. The stars given in the table are arranged approximately in the order of their brightness, the first being α Ursæ Minoris, which is taken in all cases as the standard of comparison, and the next

three, δ Ursæ Minoris, 51 Cephei, and λ Ursæ Minoris. The chart is a copy of a sketch showing the approximate relative position of ten faint stars very near the pole, which are denoted by the Italic letters, *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *k*, *l*. The places of the



DM.	α 1880	δ 1880
°	*h.* *m.*	° ′
88 8	1 14	88 40
86 269	18 11	86 37
87 51	6 44	87 14
88 112	19 44	88 57
88 4	0 51	88 23
88 9	2 3	88 36
89 3	2 28	89 36
89 35	17 50	89 48
89 37	19 28	89 54
89 1	0 19	89 45
89 26	13 23	89 49

pole for 1855, 1880, and 1900, and of five stars from the Durchmusterung, four of which occur in the table, are also indicated upon the chart, to facilitate the identification of the

faint stars. The objects called *c* and *e* are nearly in the prolongation of the line through DM. 89° 37 and *b*. Between these last, and more nearly in the same line than it appears in the chart, lies the star *a*.

The value and interest of the photometric results to be obtained at the Harvard College Observatory may be greatly increased by the co-operation of astronomers elsewhere. All who are desirous of improving the present system of comparing the brightness of stars are therefore requested to make estimates of the magnitude of as many as may be convenient of the stars above mentioned. It is desirable that the estimate should be made, for each star which may be observed, on five different nights, and that each estimate should be, if possible, entirely independent of those previously made. It will add to the value of the work if, on every occasion when the fainter stars are looked for, a record is made of such of them as can then be seen, even if no estimate of their magnitudes is attempted.

Observers are also requested to note the approximate places of any stars not represented upon the chart, but within five minutes of the place of the pole at any time between 1880 and 1900. The boundary of this region is represented on the chart by a dotted line. The stars not shown within it have been omitted as unnecessary for the purpose of finding the others, and several of these omitted stars are inconveniently faint for photometric observation; but records of their visibility at any time and place will be valuable as evidence of the state of the atmosphere and character of the instrument employed in the observations.

All astronomers who may be induced by this request to make any observations of the kind just described will confer a favour upon the Harvard College Observatory by sending to it a copy of their records, accompanied by a statement of any modification of the proposed method of observation which they may have adopted, as well as any additional details which may appear desirable, with regard to the instruments employed, etc. Unless the contrary is requested, the results will be published with the photometric measurements obtained at the Harvard College Observatory; and a copy of the publication will be sent to each observer who has co-operated in the work.

It is hoped that a large number of those astronomers whose experience has been sufficient to establish a definite scale for their estimates of stellar magnitude will consent to take part in the proposed observations, in order that the published series of observations may be complete enough to be of general utility.

EDWARD C. PICKERING,
Director of the Harvard College Observatory.

A RETROSPECT.

It is a retrospect of upwards of 50 years, a space of time covered by many memorable events, discoveries, and improvements relating to astronomy. Excellent work was done 50 years ago, but principally by the distinguished leaders in the science, the love and pursuit of which had not permeated all classes, and the number of amateurs was small indeed compared with official astronomers. Books were few, instruments expensive. The largest achromatic was that of nearly 10-in. aperture, made by Fraunhofer for the Dorpat Observatory.* The observatories of the Cape and of Cambridge had only been founded a few years. The publication of the *Monthly Notices* of the R. A. S. were of quite recent date. Whoever can get a sight of a *Nautical Almanac* of those days will be struck by the immense improvement it has since undergone, besides being reduced in price one-half, although so much increased in size. Pond presided at the Royal Observatory, and its present distinguished head was carrying on his excellent system of work and observation at the Cambridge Observatory, commencing afterwards, as successor to Pond, those labours which have made the Greenwich Observatory at least second to none in the world. We remember in early youth wishing our lot had been to occupy some post within its precincts, for it appeared to us the very earthly paradise of astronomy. But it is one thing, we reflected since, to look over the wall of such an Eden, and another to be committed to the arduous labours that night and day occupy its cultivators. Sir John Herschel's observations of the sidereal heavens, in which Sir James South for a time participated, were being carried on; and the names already mentioned, besides those of Peacock, Babbage, and others, show that if in general science had been at a standstill in England, there were yet bright exceptions.† In the United States at the time we refer to, we believe there was not a single observatory of any note.

Now, to take a bird's-eye view and glance, though in a very imperfect and cursory way, at the achievements of the last half century. Observatories, national and private, have been multiplied immensely, and old ones reorganised all over the world. The number of amateur astronomers, more or less well equipped and instructed, who devote themselves either to some particular branch or desultory observing, it would be difficult to reckon.

* It cost £950, which left no profit to the Munich workshop.

† Babbage's "Decline of Science in England" was published in 1830. The year before departed Dr. Thomas Young, one of the most illustrious men of science of any country or age.

Opticians have made an astonishing advance. Telescopes, refracting and reflecting have been made of great size and admirable quality, and others still larger are in contemplation. Those of moderate size and capital performance are within the reach of persons of limited means.* It suffices to call to mind such names as those of the Earl of Rosse, Lassell, De La Rue, Grubb, Foucault, and With, for reflectors, and of Merz, Cauchoix, Alvan Clark and Sons, and Cooke for refractors, to estimate the progress made since the once unequalled workmanship of Sir W. Herschel and the Dollonds. In regard to other instruments may be mentioned the transit-circle, altazimuth, the great equatorial, and reflex-zenith tube at Greenwich, and the meridian-circle by Eichens, of the Paris Observatory, the prime-vertical instrument at Pulkova, the Oxford, Pulkova, and Dun Echt heliometers, and other first-class productions of artists like Troughton and Simms, Grubb, and Cooke in Great Britain, and Gambey, the Repsolds, and Ertel on the continent. Then there are improvements in the mountings of equatorials, in clocks and watches, the making of silvered glass specula, of photometers, heliostats, photoheliographs, photographic apparatus, and spectroscopes.

In the improvement of the lunar and planetary theories the list of illustrious workers comes down from Plana to Hansen, Adams, Delaunay, Le Verrier, and Newcomb; whilst Sir George Airy's numerical lunar theory is in progress, and others in this country and America are occupied with the subject. It is a privilege to have lived in an age in which physical astronomy achieved such a triumph as the discovery of Neptune.

"The progress of our knowledge of the sun," writes a leading astronomer, "has been so rapid that only those can completely follow it who have made it the principal business of their lives." We can only note a few heads: Le Verrier's new solar tables, a more accurate knowledge of the solar parallax, periodicity of spots, and their connection with terrestrial magnetism and auroras, gaseous nature of the red prominences, views of their spectral lines and of the prominences themselves without an eclipse, existence of vapours of sodium, iron, and many other elements in the sun,† researches on its photosphere, chromatosphere, and corona, and the probable association of the last

* When we went to India in 1829 we had a 2-in. portable telescope by Cary, still in our possession, which furnished with two Cavallo's pearl micrometers was very useful for both land and sky work. A modest little refractor, slightly larger than the above, but of much greater power, by one of our best living makers, now on our table, would have made us wild with delight in those days.

† The discovery of bright lines of oxygen in the solar spectrum by Professor H. Draper is still, we believe, under discussion.

mentioned with meteoric systems, the zodiacal light and comets, the great probability that the sun is nearly wholly gaseous. Two memorable phenomena are the astonishing solar outburst seen by Carrington and Hodgson in 1859, with the great magnetic storm and the vivid auroras which followed, and the tremendous eruption witnessed by Professor Young in 1871. Solar eclipses,* total or annular, some of them very memorable, were observed in 1831, 1834, 1836, 1842, 1851, 1854, 1858, 1860, 1865, 1867, 1868, 1869, 1870, 1871, 1874, 1878. The principles of the mutual convertibility of heat and other forces, and the conservation of force (Grove, Helmholz, &c.) are too important in their bearing on the sun to be omitted. On the motion in space of the sun and planets we have fresh investigations from Argelander (1839) to Airy and Dunkin (1860-64).

The researches of Adams (1853) and others on the moon's acceleration, and of Hansen (1867) and Delaunay on two inqualities of long period occasioned by Venus, have brought to light slow changes in the motion of our satellite which are not yet accounted for. The first part of Newcomb's great work, *Researches on the Motion of the Moon*, appeared in 1878. Whilst charming views of the moon are obtained even with small, if good, telescopes, that really show us a great deal, and seem to bring its orb into magical nearness, the most powerful have hitherto failed to elicit information on various obscure or enigmatical points. In the delineation of its surface the beautiful maps and the measurements by Lohrmann, Beer and Mädler, Schmidt, and the minute investigations by Webb, Birt, Neison, and others, the photographs by Draper, Bond, De La Rue, Rutherford, and many more, mark the great progress which has been made. Such excellent special works on the moon as those of Webb (in *Celestial Objects*, &c.), Proctor, and Neison, have only appeared in recent years. The heat emanating from the moon has been detected with the thermopile by the present Lord Rosse, and by Marié Davy, of Paris.

A movement of the perihelion of Mercury, announced by Le Verrier in 1874, inexplicable except by the existence of matter between that planet and the sun, yet awaits its full solution, but the eclipse of 1878 will be ever memorable for the discovery, whilst the sun was hid, of two, possibly more, intramercurial planets by Messrs. Watson and Swift. Whether either can be identified with Vulcan, thought to have been seen by

* Probably not many of the readers of the *A. R.* are now living who viewed the rather large solar eclipse of November 29th, 1826. We have still memoranda of our youthful observation of it, made with very humble means at a villa rather more than half-a-mile from where Galileo lived.

Lescarbault in 1859, is still doubtful. We have had seven transits of Mercury since 1829, and its mass and density have been more accurately ascertained. The transit of Venus in 1874, and the costly and elaborate preparations for its observation, made by all the civilised nations, are fresh in everyone's memory.

Concerning our own planet we have researches of Hopkins and Sir W. Thomson on its solidity and rigidity; the measurements of the great arcs of meridian in Great Britain, India, and Russia, and other important trigonometrical operations in this country and elsewhere; the more accurate determination of its mean density, figure, and dimensions by Baily, Airy, Sir H. James, Clarke, and others, the researches, amongst others, of Gauss and Sabine, on terrestrial magnetism, researches on the tides by Airy, Whewell and Lubbock, Foucault's experimental illustrations of the earth's rotation by his pendulum and gyroscope, and finally, the minute retardation of its rotation by the friction of the tides.

Tolerably accurate maps of the surface of Mars,—"The miniature of our earth," have been constructed; the discovery by Professor Hall of his two satellites and the consequent exact determination of his mass, is one of the most brilliant contributions of observational astronomy in America. This planet had furnished 12 determinations of the sun's parallax, and the observations at the opposition of 1877, by Mr. Gill at Ascension, have just afforded another, to which probably much weight will be attached. Till the discovery of Astrea in 1845 only four minor planets were known; the number is now nearly 200. Observations of Flora at opposition were employed by Galle in 1833 for ascertaining the sun's parallax, and of Juno by Lord Lindsay at Mauritius in 1874, with his fine heliometer, for the same purpose. That Jupiter and Saturn are still very hot, in fact "minor suns" to their satellites, has been made nearly certain. In relation to Saturn we have to mention the discovery of the dusky ring by the Bonds and Dawes, the satellite Hyperion by W. C. Bond and Lassell, and a much better acquaintance with the constitution of his rings through the investigations of Peirce, Bond, and C. Maxwell. Two new satellites of Uranus discovered by Lassell, the disproof of the existence of four out of the six that Sir W. Herschel thought to have discovered, the discovery of Neptune by Le Verrier and Adams, and of its satellite by Lassell, complete our brief retrospect of the planetary astronomy of the last 50 years.

Meteoric astronomy, since the time of A. Quetelet, Coulvier-Gravier, Olbers, Biot, Arago, &c., has been remarkably developed. Several hundred radiant points have been found. The researches

of Professors Newton and Adams on the meteor orbit of November, and its identification with that of the comet of Tempel, and Schisparelli's identification of the August meteors with Comet III., 1862, the verification of the prediction of the shower of November 27th, 1872, as the remains of the lost comet of Biela, are amongst the memorable advances in recent years in this department and the vast and promising subject is being systematically followed up by many able and zealous observers. The magnificent meteoric shower of 1833, seen in America, and the inferior but beautiful display in this country in 1866, must be mentioned; as well as various falls of aërolites and meteoric iron.

Comets have appeared in great numbers (on an average three a year); the most brilliant being Halley's (1835), Donati's (1858), and those of 1843 and 1861. Coggia's, in 1874, was the last conspicuous one. Some of the smaller have a peculiar importance on the grounds already stated. We have also become acquainted with four new comets of short period, known as Brorsen's, D'Arrest's, Faye's, and Tuttle's; besides the separation into two parts of Biela's comet. Through the tail of the great comet of 1868 the earth is supposed to have passed on June 30. We have seven new catalogues of comets, including that by Williams from Chinese observations.

Enormous labour has been bestowed on the stars, among the valuable results of which are star catalogues, over 70 in number, and a more extensive and precise knowledge of proper motions; above 50 catalogues of double stars, about 24 catalogues of nebulæ and clusters; about 20 series of celestial charts and atlases;* catalogues of variable and coloured stars. Parallax of α Centauri determined by Henderson and Maclear with the mural circle at the Cape; of 61 Cygni by Bessel with the splendid Königsberg heliometer, and of about 9 others by various astronomers with tolerable certainty. Accurate determination of the constants of precession, aberration, and nutation. Determination of the orbits of some binary stars with approximate mass of several. Spectrum analysis of stars. The wonderful feat of the measurement of their motion in the line of sight by Huggins with the spectroscope, and similar observations at Greenwich.

* "Uranométrie Générale," by J. C. Houzeau, Director of the Royal Observatory, Brussels, contains a list of 5719 stars, embracing the six magnitudes visible to the naked eye in both hemispheres. They are laid down on five charts, stars black on white ground, and half magnitudes are indicated by distinct signs. This quite original and independent survey of the whole heavens was made by the author in 13 months. It is in the 1st volume of the new series of "*Annales de l'Observatoire Royal de Bruxelles.*" 1878.

Discovery by Huggins of the gaseous nature of some planetary and other nebulæ. Existence of variable nebulæ. Detection of the motion of groups of stars, or star-drift, and novel views of the structure of the heavens by Proctor. Discovery of the companion of Sirius by Alvan Clark. Much has been done in celestial photometry; and amongst new or temporary stars must be mentioned the one of the second magnitude which suddenly appeared in Corona Borealis in 1866.

The departments of celestial photography and spectroscopy which may be said to have been added to astronomy about 40 and 20 years respectively, and to have commenced with Dr. J. W. Draper's photographs of the moon in 1840, and Kirchhoff's discovery in 1859, have been amazingly extended. Amongst the host of meritorious workers and artists, suffice it to refer to the present labours in solar photography of Janssen at Meudon, and the refined and beautiful spectroscopes constructed by Browning. The determination experimentally of the velocity of light (attempted in vain by Galileo) by Fizeau, Foucault, and Cornu, and about to be repeated in America, the application of electro-magnetism to the determination of geographical longitudes, and to astronomical purposes are both of great importance.

The ever-interesting controversy about the plurality of worlds has assumed new phases in the lights and discoveries of recent years. Flammarion in France, and Proctor in this country, have both contributed works of much value on the subject, and thus we are led finally to the book department of our science, and contrast its richness with the poverty of fifty years back. Some of the valued companions of those early years we still possess, but there was nothing then like, for example, the "Descriptive Astronomy" of Chambers, the "Astronomy without Mathematics" of Beckett, the "Practical Astronomy" of Loomis, the "Popular Astronomy" of Newcomb. We have now many admirable works, scientific and popular, general and special, and often illustrated by drawings of exceeding and formerly unknown beauty. The branch of physical astronomy is perhaps the least full. We do not know that there is any more recent work published in this country that covers the entire ground of theoretical astronomy than Mrs. Somerville's "Mechanism of the Heavens" (1831). The larger number of our excellent English books are indeed of comparatively recent date. Amongst the older ones the charming "Cycle of Celestial Objects" appeared in 1844, and was long an unique work. Narrien's meritorious "Practical Astronomy and Geodesy" came out in 1845. Sir John Herschel's observations at the Cape were published in 1847, and his "Outlines," &c., and Airy's Ipswich lectures first appeared in 1849. Grant's "History

of Physical Astronomy," in 1852, Lardner's "Handbook" in 1833. New ephemerides and periodicals have started into existence; amongst the latter the *Astronomical Register*, which first appeared in 1863, the earliest and, till recently, the only English serial exclusively devoted to astronomy. We have now also *The Observatory*, edited by W. H. Christie, which commenced in 1877. It is gratifying that persons of fortune in England and abroad have advanced the science by the resources of their wealth, and often likewise by their own proficiency.

"A cloud of obliviousness," says Pindar, "is apt to come over the mind in a baffling way, and divert it from the right course of things."* And this he illustrates by a rather glaring instance of forgetfulness. We hope we may not have afforded another, but an uncomfortable feeling possesses us that we may have inadvertently omitted some items that should be noted even in so sketchy a review as the present. There is an element of regret, too, in the retrospect we have endeavoured to take—the extinction of so many luminaries to whom astronomy has been so much indebted. We believe that over 90 astronomers and mathematicians of more or less note have passed away from us. We cannot give all their names here, but only a selection, with the years of the century in which they died. Legendre, 33, Olbers, 40, Poisson, 40, Bessel, 46, Gauss, 55, Biot, 62, Plana, 64, W. Struve, 65, Earl of Rosse, 67, Dawes, 68, Sir John Herschel, 71, Delaunay, 72, Mrs. Somerville, 72, Mädler, 74, Hansen, 74, Pontécoulant, 74, Argelander, 75, Le Verrier, 77. Personally we had not the fortune to know above a few in the long list. They were Inghirami, of Florence, Pons, of cometary fame, Von Zach, and Taylor of the Madras Observatory.† But if our losses have been great it cannot be said that, besides a few of eminent celebrity, we have not also many given to the pursuit of the science in England, in America, on the continent, from whose past and present labours a very hopeful augury of the future may be entertained. Much has been achieved in the last fifty years, more than the most sanguine could have anticipated. But very much yet remains for investigation and discovery in every department, whether of theoretic or observational astronomy. What would we give to be able to survey the progress that may be looked for in *another* half century! May He whose glorious works it is the privilege of the

* Olymp. VII.

† This zealous astronomer could also turn his hand to other things. In those days one taking an early morning ride at Madras, might sometimes meet a carriage and pair with a rider on one of the horses, his toes well turned out, and trousers far up his legs for lack of straps, with a pair of spectacles, and a singular topy or hat. This was Taylor, who had recently taken a wife, breaking in the horses for his lady's carriage.

astronomer to know so much of, and to whom he owes the faculties and means for their study, grant that increasing knowledge may be accompanied by increasing piety; and finally, when we shall have turned our telescopes for the last time to those heavens which declare His glory, and for the last time used our pens for calculation or analysis, we may be permitted to resume, with the nobler powers and the greater facilities of a future life, the much loved though ever imperfect studies of the present.

REVIEWS.

Report of the observations of the Total Solar Eclipse, July, 29th 1878, *made at Fort Worth, Texas.* Edited by Leonard Waldo, Assistant at the Observatory of Harvard College. pp. 60. 4 plates. Cambridge: Press of John Wilson and Son, 1879.

The generosity of the gentlemen who materially aided in the observations of this eclipse is fitly acknowledged in the first place, and their names are given. Then we have a description of the *personnel* and outfit of the expedition. Time observations, longitude determination, latitude observations, and geographical positions, the several reports of MM. Leonard Waldo, R. W. Willson, Professor J. K. Rees, MM. W. H. Pulsifer, and F. E. Seagrave; finally reports from other co-operating observers. The special end in view was the observation of the corona with the naked eye, the telescope, spectroscope, and the polariscope. Under the observations for latitude, Mr. Waldo describes his method of determining the eccentricity of a sextant by comparison with a large meridian circle to which it is attached; so that he was able to find the correction due to any angle, up to 120° when it amounted to 15·9″. There were no means, however, of determining the effect of heating the sextant so hot as it became during observation. Besides general oversight and arrangements, Mr. Waldo undertook the photographic work. Just before the commencement of totality he glanced towards the ground where his attention was drawn to a fluttering motion of something, he did not know what. He says, "Every eye but mine was towards the eclipsed sun. I quickly removed the cap of the camera-box to make an exposure, and again looked at the ground, away from the eclipsed sun. What I had suspected before I was now certain of. There were flitting shadows moving swiftly towards the east and south-east. They seemed to me regular in their occurrence, both as to time and distance apart; but how far apart they were or how many occurred in a second I cannot form an estimate, other than that they seemed like dark crests to waves, and might be a hundred feet apart, occurring three in a second. Of the existence of this phenomenon I am positive; but the estimates of magnitude and frequency of these shadows should be received with the greatest caution. I suppose this to be an observation of the shadows ordinarily seen at the second contact of total solar eclipses. The faculæ were seen clearly up to within about 2″ of the moon's limb, and Mr. Waldo *thinks* they were sharp to the very edge. There was a minute point of light separated from, and in the line of, a prolongation of one of the sun's cusps. Mr. Willson, who says the definition was such as left nothing to be desired, saw no evidence of a lunar atmosphere, the faculæ retaining their shape quite unaltered as they were covered by the advancing limb; the cusps were throughout sharply defined. At 44·16m. the extremity of the lower cusp was separated from

the remainder of the visible portion of the sun. Professor Rees says, "The serrated edge of the moon could be made out very distinctly. I was struck with the appearance of faint dots of light, almost like faculæ, at end of each cusp, say 3″ to 5″ in diameter . . . . to my eye the dots were always present distinctly, though faint . . . . . the faculæ and mottled appearance of the sun it seemed to me did not come in contact with the moon's limb, but stopped short of it. He was disappointed in the brightness of the corona, but judged only from what he had read, and the impressions derived from pictures. "It was of a beautiful soft silver-grey colour to my eyes, and was wing-shaped, the two wings being situated in the ecliptic as nearly as I could judge." The light of the wings appeared made up of rays parallel to each other and to the line of the ecliptic. This parallelism was very distinctly marked, and a fine sight. The enchanting view so riveted the professor's attention that the seven seconds he had intended to devote to the naked eye view became about twenty. At the call of Mr. Lomax he adjusted the slit and observed a continuous spectrum, with no lines whatever. He expected to see bright lines, but having enlarged the slit, again obtained a continuous spectrum, this time crossed by *dark* lines, among which C and D were plainly visible; this was some ten seconds before the flood of light came. Mr. Pulsifer observed the granulations and faculæ well defined close up to the limb of the moon. The atmosphere in the direction of the sun seemed perfect for spectroscopic work, and Mr. Pulsifer thinks he never had better definition. "Waiting for the second contact, the last moments seemed interminable. The excitement was intense. The strain upon my eye was so great that I feared my sight would fail me entirely below the contact. At last there came a flash and the lines blazed out brightly, appearing to fill the field completely for an instant. Although expecting this phenomenon, I was fairly surprised; and I was startled, also, to find the bright lines *shortened at each end*, and occupying but about one-third of the width of the spectrum . . the lines were sharp and well defined, very narrow, and not at all nebulous, except that the ends seemed rounded off. *The C line did not shorten*, and was in view after the other lines had disappeared. The reversal of the lines was so sudden and evanescent, and the shortening so astonishing, that I utterly failed to notice the length of time they were in view; nor did I observe any continuous spectrum, unless the first flash, which seemed to fill the field with light, might be taken as such. I am not certain that all the lines were reversed." It occurred at last to Mr. Pulsifer that the shortening of the reversed lines was owing to the image of the sun formed on the slit being so small, (0·54 in.) and the reversion layer so thin that the *slit extended beyond the layer on each side*, and that this only would explain the normal condition of the C line, and the shortening of the others. He availed himself of this combination of circumstances to measure the thickness of the reversion layer, as represented by the lines in view, which he made to be 524 miles.

When the last ray of sunlight disappeared Mr. Seagrave looked very carefully for the famous 1474 line of the coronal spectrum. At first he saw nothing, but on widening the slit he saw one bright line which was quite faint and not very well defined; this was the only line in the field. He had hardly time to secure one measure of its width when the sun re-appeared. Faculæ, &c., appeared just as well defined near the moon's limb as at some distance from it. The darkness was not so great as anticipated, although a lantern had to be used to record by. Venus was shining brightly in the north-west, and the whole sky in the north and

east had a most beautiful orange colour. The thermometer fell 11·7 degrees since the time of first contact.

Mr. Waldo, with Mr. Freeman their photographer, took five negatives, of which a somewhat enlarged copy of No. 3. (exposure 17s.) forms plate I. The positions of certain striæ, evident in the photograph, were carefully measured and computed; it is uncertain whether they represent prominences, or a greater intensity of coronal light only at the points whose position angles are given. There seems to have been some evidence obtained, though not incontrovertible, of the tangential polarization of the light of the corona. Professor Lockett's drawing (plate III.) is an excellent representation by a careful draughtsman of the corona seen by the naked eye. Plate II. represents its very irregular appearance as seen by Mr. Willson, with an inverting telescope. He followed the light certainly more than 45′ from the sun's disc. Several prominences were visible . . . . one of them of considerable size, and sickle-shaped. They were of a pale pink colour.

In this eclipse expedition everything seems to have been done that excellent pre-arrangement, organization, and, where practicable, rehearsal could effect; and it is a model for similar occasions. The report has a permanent value. The clear and conscientious record of observations, well made and well treated, is up to the high mark which astronomical science has reached in the United States. In spite of some mishaps and failures the work was generally successful, and the thanks of astronomers, and of the students of solar physics in particular, are due to Mr. Waldo, and to all who contributed to the prosperous result.

The Total Solar Eclipse of July 29th, 1878. By Professor Henry Draper, M.D. Reprinted from the Journal of the Franklin Institute for October, 1878. Philadelphia, 1878. pp. 4.

The observations were made at Rawlins, Wyoming County, and the expedition consisted of Professor and Mrs. Draper, Professors Morton and Barker, and Mr. Edison. They were well provided with instruments which are described, and the programme was successfully carried out. The photograph of the diffraction spectrum of the corona showed that the corona on this occasion did not consist of an incandescent gas giving a few bright lines, but that its light was due to reflection of sunlight by solid or liquid bodies surrounding the sun like a cloud of meteors. Prof. Draper says: "The plain photograph of the corona (see plate) shows that the great mass of the matter lies in the plane of the ecliptic, but not equally distributed, for on this occasion it extended about a degree and a half from the sun towards the west, while it was scarcely a degree in length towards the east. The photograph also shows curious ray-like forms of coronal matter towards the poles of the sun. There can be but little doubt that during this eclipse we have observed the true nature of the corona, and that its light is almost altogether sunlight reflected from bodies of a size too small to be distinguished as individuals. According to this view, the light of the corona has, on former occasions, been infiltrated with materials thrown up from the chromosphere, notably with the 1474 matter and hydrogen. The 1474 line can be seen on any occasion favourable for observations in the chromosphere of the sun. As the chromosphere is now in a quiescent condition, this 1474 matter had not been projected into the corona as in former eclipses, and hence, probably, the pearly white colour of the corona on this occasion." The observations of Professors Barker and Morton confirmed this theory that the corona shone by reflected sunlight at this time, for Professor Barker with the analyzing spectroscope observed the dark Fraunhofer lines in

the corona, and the polarization was shown by Professor Morton to be such as would answer to reflected solar light. Professor Morton also observed the dark Fraunhofer lines in the coronal light with a hand spectroscope. Mr. Edison used his newly-invented tasimeter, to ascertain whether the corona gave indications of heat. The instrument, however, was found to have been over-sensitively adjusted, for the moment the tasimeter was moved from the image of the dark moon to the image of the corona, the index-beam of light went entirely off the scale of the galvanometer. Such were the satisfactory results of this expedition.

Note on J. C. Draper's paper On the presence of dark lines in the solar spectrum which correspond closely to the lines of the spectrum of oxygen. (From the American *Journal of Science and Arts*, Vol. XVII., February, 1879.) pp. 4.

This paper, signed G. F. B., gives the writer's reasons for believing that errors of method and experiment make it quite impossible to accept the conclusions reached by Mr. J. C. Draper, and that the results given are entirely vitiated by them. He adds a caution: "The author must not be confounded, because of the similarity of initials, with the distinguished investigator, Dr. J. W. Draper."

Meteorological Observations made at the Adelaide Observatory during the year 1878, under the direction of Charles Todd, C.M.G., F.R.A.S., Observer, Postmaster-General, and Superintendent of Telegraphs. Published by authority of the Government of South Australia. Adelaide, 1878.

These observations extend from January to July, 1878, inclusive, and appear to be of the same fulness and accuracy as those we had occasion to notice before. The introduction describes the instruments, and the characteristics of each month follow the usual register; lastly a sheet presents the meteorological curves, Barometer wind, temperature, humidity, ozone, rain, and evaporation, and also amount of cloud, and velocity of wind. For the rainfall a number of gentlemen have for many years co-operated, and the number of stations in the beginning of 1878 was 110. We can hardly conceive meteorological observations of a more thorough character.

Astronomie Sidérale. Catalogue des Étoiles doubles et multiples en mouvement relatif certain, comprenant toutes les observations faites sur chaque couple depuis sa découverte, et les résultats conclus de l'étude des mouvements. Par Camille Flammarion, Astronome, Ancien Membre de l'Observatoire de Paris, Membre de la Société Royale Astronomique de Londres, &c. Paris: Gauthier-Villars. 1878. pp. xviii. 184. 7 fr.

We are indebted to M. Flammarion for a work the want of which must have been long felt both by professional and amateur astronomers. Besides receiving communications from astronomers in all parts of the world, M. Flammarion was enabled by M. Le Verrier to make original observations with the great equatorial of the east tower of the Paris observatory:—the first time a series of measurements of double stars has been made in a French observatory. All accessible catalogues and memoirs have been examined, and the object has been to omit no micrometric measurement, and to note every observation made on every star since its discovery. It was necessary at the outset to construct a catalogue of proper motions of stars, which is now in the press. M. Doberck having specially given himself to the careful calculation of the orbits of

stellar systems, M. Flammarion has discontinued this part of the work, and availed himself of the labours of that astronomer. Positions in R. A. and P. D. are brought up for precession to 1880. The examination of the 5.000 nebulæ hitherto observed has made it appear that some *double nebulæ* are in motion. These are also noted. Great as was the labour of preparing this volume, into which, by the arrangement of three columns on a page, it has been possible to condense a great mass of matter, the author justly regards it as only a first attempt, and he hopes it will be continually improved and enriched by the assistance of astronomers.

It forms the second part of a general work on double stars, which will shortly appear. After the introduction there follow original micrometric measurements; the catalogue of double and multiple stars in sure relative movement, in the order of their R. A. additions to the catalogue whilst printing, double nebulæ in movement, classification of double stars in movement, physical pairs whose components are fixed; lastly, an index.

M. Flammarion remarks, "Various causes quite distinct affect double stars so as to give them a real or apparent motion: the gravitation of the components of a binary, ternary, or multiple around their centre of gravity; the gravitation of two or more stars carried together in space under the influence of unknown sidereal attractions; [61 Cygni, for instance, which does not follow the orbit of Bessel.] the different proper motions of two remote stars fortuitously placed on our visual ray; to which we must also add the secular translation of our solar system in space, which reflects itself by giving to the less distant stars an apparent displacement in an opposite direction." Examining the list of 101 observers referred to, we find none omitted that we know of. Mr. Plummer's observations in No. 1 of the Oxford University Astronomical Observations must have appeared too late to be available. Rich and valuable instalments of double star work have been contributed by many, but no one, it would seem, had hitherto the means, time, courage, ability, and love of the subject combined, which have enabled M. Flammarion to produce the present comprehensive and admirable volume. Its moderate price places it within the reach of all who occupy themselves with this department of astronomy, and it is therefore unnecessary to extend this notice of it. In a postscript the author says that what has cost him long years of research might, possibly, never have seen the day but for M. Gauthier-Villars, who has rendered so many services to the spread of science in France.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.
To all communications must be annexed the name and address of the sender, as a guarantee of good faith.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

SUN-SPOTS AND THE WEATHER.

We have received a long letter from Professor Piazzi Smyth, complaining of an article upon sun-spots and the weather, which

appeared in August, 1878. We have much pleasure in putting his views before our readers in the following extracts:

1. By a general review of Sir G. B. Airy's Greenwich report for this month, I gather that he has not only begun to examine into the dependence of terrestrial magnetism on the sun-spots, from Greenwich observations, but has become amazingly impressed with its truth, and is about to make it a leading feature in the Greenwich magnetical, meteorological and astronomical observations combined. In fact he indicates that he is ready to *recede* from the ordinary magnetical and meteorological work as hitherto prosecuted, and to take up their solar connections instead. Wherefore your leading article, denouncing that there is no scientific truth whatever in sun-spots and earth meteorology, but only the machinations of a gang of pseudo-scientists seeking to pocket public money, falls to the ground at once and completely.

2. If the sun is to be observed for its influences on the earth, of course that part of the world where the sun is oftenest seen high in a blue sky is a better situation than another where the sun never attains a very high position, and where the sky is proverbially cloudy. Hence if there was only to be one British Solar Observatory, India, and not Greenwich, should be its locality. But in any important branch of astronomy there should always be more than *one* observatory devoted to it. Wherefore I have no objection to Greenwich trying to do what they can, their natural obstacles notwithstanding, but would expect, with equally good men in India, better results from them.

3. But you bring up all sorts of objections against an Indian Solar Observatory, which you do not venture to bring up against a Greenwich or Kew Observatory, although you might do so with more reason. You want, for instance, to relegate the whole matter of solar observations and meteorology, when India is concerned, to amateurs! Are amateurs for such work more plentiful in India than in and about London, Greenwich, and Kew? And where is the amateur who will go on for years and years injuring his health and shortening his life, and expending his income, in gathering painfully the thousands and thousands of glass photographs of the sun which form only the beginning of the enquiry? Will your friend, who wrote your leading article, go out to India and do all that the scientific public demands, with his own hand and at his own cost, if he is only assured that no public observatory shall be established in India, to do the like things? And will he insure himself from dying, as poor Capt. Jacob did, within a few weeks of landing, and his instruments being lost or condemned to rot unused?

4. But you have further arguments against the Indian Solar

Observatory: first, that you think Indian money should not be spent upon it: second, that the salaries were to be too high; and, third, that there was to be something secret in the appointments to it.

Now, the first objection does appear to me most absurd, if not worse, for the purpose of such an observatory is Indian mainly, *viz.*, connected with making some approximations to the periods and cycles of Indian famines, and thereby saving the lives of millions of its inhabitants and tens of millions of its rupees, while the radicals of India complain, not so much of establishments in India, that must employ some native help, and must spend on men living *in* their country, but of absenteeism—of Indian money spent in England—that is what they are agitating against.

Second, as to the salaries proposed being higher than those at home, in observatory positions—that is perfectly right and necessary for Europeans in India. Their lives are shortened by the climate, and through all classes of employment under government Indian salaries are higher than British. Why, then, should an astronomer's form the only exception? What a misfortune it is for the Madras Observer at the present moment, that his salary, though fair enough at home, is miserable in India. There he is, without any promotion to look forward to, his life rapidly shortening, his strength failing, his income too small to save on and come home, and then, amongst his other duties, he has to descend scientifically to teach Indian army officers the art of levelling, so that they may then get higher salaries than his, in the irrigation works of India, their military rank growing all the time, so that those who began as lieutenants are presently majors, colonels, generals, and retire with a very comfortable provision for their latter years; while the poor astronomer can do little more than either fly as a pauper, or perish at his post—thanks in no small degree to the miserable jealousies and envyings of those at home who should have been his best friends.

Third, you object that there was going to be something secret in making the appointments to this most unenvious establishment of an Indian Solar Observatory. . . . . But I do not know that there was anything different in this case from the usual mode of proceeding in all Government's arrangements for work.

Your unknown writer would fain have had the Government bow down to the Astronomical Society, and humbly crave that body to appoint their officers for them.

Did the Government descend in any such manner when they appointed officers to the South African army! or do they in the civil Government of this country apply to private societies to advise them who to appoint? I should rather imagine not; a

strong Government has good administrators, and such men often know much better what men to appoint to unusual and difficult posts, than experts in the sciences themselves: and not until the Government of the country has ceased to be a Government, need one or two, or two or three, or even two or three hundred scientists meeting together, expect that they are going to become the Government in what they think they know better about than other people; yet a still greater number of the same sort of scientific people in other parts of the country may consider that the said knot of two or three hundred in one place may not fully appreciate, and are not to be trusted to legislate for, and appoint to—unless they will bear all the expenses themselves and make it their own affair—when they may rest assured that no honourable man from the outside will interfere with them in carrying it out, and no just man will refuse his meed of praise if they attain to success after many years.

15, Royal Terrace, Edinburgh:
June 23, 1879.

SWIFT'S COMET.

Sir,—The new comet, discovered by Mr. L. Swift in America, has been visible during July, but is passing away both from the earth and the sun. Elements have been calculated by M. Zelbr, of Vienna, and M. Winnecke, of Strasburg, but as they are only provisional it will be better to await for more exact results. It was calculated by M. Zelbr that on July 15, at 6h. Berlin time, the comet would be within about one minute of arc of the north pole, probably a nearer approach to the pole than ever before known. During the whole time of its visibility the comet has been within a few degrees of the pole, which in itself is not a very common circumstance. I may add that it does not at present appear that the elements resemble those of any comet previously observed.

Northfield Observatory, Your obedient servant,
Eastbourne: July 23, 1879. G. F. CHAMBERS.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN AUGUST, 1879.

By W. R. Birt, F.R.A.S., P.S.S.

Errata in list for July. In transcript of Mr. Gray's observations, "For the first time Peirce A was *observed*" read *obscured*. In the last paragraph, line 2, for *duration* read *direction*.

Dennett's Streak VIII. from Proclus. The observations recorded in our last list are conclusive as to this particular streak having undergone a slight change in its direction, sometimes obscuring the crater

Peirce A and sometimes being seen quite clear of it. The most recent observations by Dr. Gray indicate that the crater is obscured at about 9·0 of the moon's age. Mr. Gray's record of his observation is as follows: 1879, June 28, 10·0, "The dark region round Proclus is bounded by a brilliant white tract, from which the streaks, etc., take their rise." Mr. Gray again saw the slight curve, which on this occasion (June 28) obscured Peirce A.

Desiderata with regard to this streak: 1. The earliest epoch at which it makes its appearance, stretching from Proclus over the *Mare*. 2. The exact direction which it takes when first seen. 3. The successive directions as observed from night to night. 4. The epoch of its latest appearance for the present. The epochs of these phases may be expressed in terms of the moon's age.

Water Lane, Stratford, E.:
July 21, 1879.

P.S.—The Rev. W. J. B. Richards recorded on April 3 and 4, 1879, the interior of Proclus very clearly defined.

THE PLANETS FOR AUGUST.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury...	1st	10 25 11	N. 7 31	8″·4	1 46·0
	9th	10 34 20	N. 4 57	9″·6	1 23·7
	17th	10 24 16	N. 4 57	10″·6	0 42·2
	25th	9 57 34	N. 8 24½	10″·4	23 40·2
Venus ...	1st	11 32 59	N. 1 16	29″·4	2 53·6
	9th	11 52 48	S. 2 8	33″·0	2 41·9
	17th	12 8 18	S. 5 13	37″·2	2 25·9
	25th	12 18 6	S. 7 48	42″·4	2 4·2
Mars ...	1st	2 16 54	N.11 2	12″·6	17 35·1
	9th	2 34 19	N.12 29	13″·3	17 21·1
	17th	2 50 41	N.13 46½	13″·9	17 5·9
	25th	3 5 43	N.14 54½	14″·7	16 49·4
Jupiter ...	1st	22 52 46	S. 8 34½	45″·2	14 11·6
	9th	22 49 47	S. 8 55	45″·6	13 37·1
	17th	22 46 19	S. 9 17½	46″·0	13 2·2
	25th	22 42 31	S. 9 41½	46″·2	12 27·0
Saturn ...	1st	1 1 59	N. 3 51	16″·8	16 20·4
	9th	1 1 36	N. 3 46	17″·0	15 48·6
	17th	1 0 49	N. 3 39	17″·2	15 16·3
	25th	0 59 40	N. 3 30	17″·4	14 43·7

Mercury is too close to the sun to be well observed.

Venus sets an hour and a half after the sun on the 1st, the interval decreasing.

Mars is visible from an hour and three quarters before midnight, at the beginning of the month, the interval increasing.

Jupiter rises about an hour after sunset on the 1st, the interval decreasing. He rises about sunset on the last day.

Saturn rises about two hours and a quarter after sunset, at the beginning of the month, the interval decreasing.

ASTRONOMICAL OCCURRENCES FOR AUGUST, 1879.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Altair.
Fri	1	19 12	○ Full Moon			—
		13 6	Occultation of υ Capricorni ($5\frac{1}{2}$)			11 4·2
		14 16	Reappearance of ditto			
Sat	2		Sidereal Time at Mean Noon 8h. 42m. 50·14s.	4th Ec. D.	14 15 38	11 0·3
				3rd Sh. I.	15 46	
Sun	3		Sun's Meridian Passage 5m. 58·30s. after Mean Noon			10 56·4
		12 3	Occultation of ρ Aquarii ($5\frac{1}{2}$)			
		13 17	Reappearance of ditto			
Mon	4	8	Conjunction of Moon and Jupiter 5° 41′ S.	2nd Sh. I.	14 2	10 52·4
		8	Neptune at quadrature with the Sun	2nd Tr. I.	15 21	
				1st Sh. I.	15 53	
Tues	5			1st Ec. D.	13 8	10 48·5
				1st Oc. R.	16 3	
Wed	6			1st Sh. I.	10 22	10 44·6
				1st Tr. I.	10 59	
				3rd Oc. R.	11 40	
				1st Sh. E.	12 41	
				2nd Oc. R.	12 51	
				1st Tr. E.	13 18	
Thur	7	6	Conjunction of Moon and Saturn 8° 26′ S.	1st Oc. R.	10 30	10 40·6
Fri	8		Saturn's Ring: Major axis=42″·15 Minor axis= 7″·59			10 36·7
Sat	9	14 8	☾ Moon's Last Quarter			10 32·8
		12 29	Occultation of ε Arietis ($4\frac{1}{2}$)			
		13 33	Reappearance of ditto			
		5	Conjunction of Moon and Mars 7° 55′ S.			
Sun	10	11 33	Near approach of 23 Tauri (5)			10 28·8
		12 49	Near approach of 27 Tauri (4)			
		12 52	Near approach of 28 Tauri ($5\frac{1}{2}$)			
Mon	11			4th Tr. E.	9 50	10 24·9
				2nd Sh. I.	16 39	
Tues	12			1st Ec. D.	15 3 3	10 20·9
Wed	13	15 48	Near approach of B.A.C. 2154 ($6\frac{1}{2}$)	3rd Ec. D.	9 44 28	10 17·0
				2nd Ec. D	11 24 9	
				1st Sh. I.	12 16	
				1st Tr. I.	12 43	
				1st Sh. E.	14 35	
				3rd Oc. R.	15 0	
				1st Tr. E.	15 2	
				2nd Oc. R.	15 6	
Thur	14	14 7	Near approach of 63 Geminorum ($5\frac{1}{2}$)	1st Oc. R.	8 24	10 13·1
Fri	15		Illuminated portion of disc of Venus=0·288	2nd Sh. E.	8 52	10 9·2
				1st Sh. E.	9 4	
			Illuminated portion of disc of Mars=0·848	1st Tr. E.	9 28	
				2nd Tr. E.	9 39	
Sat	16		Sidereal Time at Mean Noon 9h. 38m. 1·92s.			10 5·2

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sun	17		Sun's Meridian Passage 3m. 56·58s. after Mean Noon			Altair. —
		8 10	● New Moon			10 1·3
Mon	18	2	Conjunction of Moon and Mercury 1° 27′ S. Venus at greatest brilliancy			9 57·4
Tues	19			4th Ec. D.	8 29 4	
				4th Oc R.	15 27	9 53·4
Wed	20	6	Conjunction of Moon and Venus 0° 27′ N.	3rd Ec. D.	13 45 30	
				2nd Ec. D.	13 58 59	
				1st Sh. I.	14 10	
				1st Tr. I.	14 27	9 49·5
				1st Sh. E.	16 30	
				1st Tr. E.	16 45	
Thur	21			1st Ec. D.	11 26 32	
				1st Oc. R.	13 58	9 45·6
Fri	22			2nd Sh. I.	8 36	
				1st Sh. I.	8 39	
				1st Tr. I.	8 53	
				2nd Tr. I.	9 4	
				1st Sh. E.	10 58	9 41·6
				1st Tr. E.	11 11	
				1st Sh. E.	11 29	
				2nd Tr. E.	11 55	
Sat	23	16	Inferior conjunction of Mercury and Sun	1st Oc. R.	8 24	9 37·7
		3 11	☽ Moon's First Quarter			
Sun	24	7 2	Occultation of B.A.C. 5347 (5)	3rd Tr. E.	8 3	9 33·8
		7 11	Reappearance of ditto			
Mon	25	8 5	Occultation of B.A.C. 5800 (6½)			9 29·8
		9 17	Reappearance of ditto			
Tues	26					9 25·9
		7 17	Occultation of B.A.C. 6576 (6)	1st Sh. I.	16 4	
Wed	27	8 28	Reappearance of ditto	1st Tr. I.	16 10	9 21·9
		20	Conjunction of Moon and Uranus	2nd Ec. D.	16 33 57	
			Saturn's Ring: Major axis=43″·39	1st Ec. D.	13 21 32	
Thur	28		Minor axis= 7″·53	1st Oc. R.	15 42	9 18·0
				1st Sh. I.	10 33	
				1st Tr. I.	10 36	
				1st Sh. I.	11 15	
Fri	29			1st Tr. I.	11 21	9 14·1
				1st Sh. E.	12 52	
				1st Tr. E.	12 54	
				2nd Sh. E.	14 7	
				2nd Tr. E.	14 11	
Sat	30			1st Oc. D.	7 50	
				1st Oc. R.	10 8	9 10·2
		6 57	○ Full Moon	3rd Sh. I.	7 49	
Sun	31	1	Jupiter at opposition to the Sun	3rd Tri. I.	7 50	
				2nd Oc. R.	8 39	9 6·2
		10	Conjunction of Moon and Jupiter 5° 28′ S.	3rd Tr. E.	11 19	
				3rd Sh. E.	11 24	
SEP	T.	11 32	Occultation of 15 Piscium (6½)			
Mon	1	12 44	Reappearance of ditto			9 2·3

JUPITER.

1879. oh. Gr.	Angle of position of 24's axis.	Latitude of Earth above 24's equator.	Latitude of Sun above 24's equator.	Equat. diameter.	Greatest phase.
	°	°	°	″	″
Aug. 3	335·47	+1·51	+1·05	47·75	0·13
13	335·59	1·51	1·10	48·53	0·06
23	335·75	+1·49	+1·14	48·99	0·01

The assumed First Meridian passes the middle of the illuminated disk at the following times:

1879.	G. M. T. h. m.		h. m.		h. m.
Aug. 1	10 23·1	Aug. 12	4 22·5	Aug. 22	22 21·8
	20 18·4		14 17·8	23	8 17·1
2	6 14·0	13	0 13·2		18 12·5
	16 9·2		10 8·5	24	4 7·8
3	2 4·5		20 3·9		14 3·2
	11 59·9	14	5 59·3		23 58·5
	21 55·2		15 54·6	25	9 53·9
4	7 50·6	15	1 49·9		19 49·3
	17 46·0		11 45·3	26	5 44·6
5	3 41·3		21 40·7		15 40·0
	13 36·7	16	7 36·1	27	1 35·3
	23 32·1		17 31·4		11 30·7
6	9 27·4	17	3 26·8		21 26·1
	19 22·8		13 22·1	28	7 21·4
7	5 18·1		23 17·5		17 16·8
	15 13·5	18	9 12·8	29	3 12·1
8	1 8·9		19 8·2		13 7·5
	11 4·2	19	5 3·5		23 2·9
	20 59·6		14 58·9	30	8 58·2
9	6 54·9	20	0 54·2		18 53·6
	16 50·3		10 49·6	31	4 48·9
10	2 45·7		20 45·0		14 44·3
	12 41·0	21	6 40·3	Sept. 1	0 39·7
	22 36·4		16 35·7		10 35·6
11	8 31·7	22	2 31·0		
	18 27·1		12 26·4		A. M.

THE INNER SATELLITES OF SATURN.

Major and minor semi-axes of the apparent orbits of the satellites, expressed in semi-diameters of Saturn's equator.

		Mimas.	Encel.	Tethys.	Dione.	Rhea.
Major		3·14	4·03	4·99	6·40	8·93
Minor	Aug. 3	0·57	0·73	0·90	1·15	1·61
	„ 13	·56	·72	·89	1·14	1·59
	„ 23	0·55	0·71	0·88	1·12	1·57

In these orbits the satellites move in the direction of decreasing position angles.

Approximate Greenwich times of some of the conjunctions of the satellites with the centre of the ball and with the ends of the ring:

"inf." inferior conjunction with centre of ball or satellite, exactly in the direction of the minor axis of the ring, north, moving from the following to the preceding side.

"sup." superior conjunction with centre of ball or satellite, south, moving from the preceding to the following side.

nf. Satellite in conj. with following edge, north, moving towards the ball.

np.	„	„	preceding	„	„	away from	„
sf.	„	„	following	south	„	„	„
sp.	„	„	preceding	„	„	towards	„

1879.	Gr. M. Time. h.			
Aug. 2	17·1	Dione	inf.	n.
3	13·0	Encel	sf.	
4	15·3	Encel	sp.	
5	10·8	Dione	inf.	n.
—	14·3	Encel	np.	
—	21·4	Tethys	nf.	
6	16·6	Encel	nf.	
—	19·6	Dione	sup.	s.
—	20·0	Tethys	sp.	
7	14·2	Rhea	sup.	s.
—	18·7	Tethys	nf.	
8	17·3	Tethys	sp.	
9	13·3	Dione	sup.	s.
—	16·0	Tethys	nf.	
—	20·4	Rhea	inf.	n.
10	14·6	Tethys	sp.	
11	13·3	Tethys	nf.	
12	11·9	Tethys	sp.	
—	19·0	Tethys	sf.	
13	10·6	Tethys	nf.	
—	13·0	Encel	nf.	
—	15·6	Dione	inf.	n.
—	17·7	Tethys	np.	
14	8·8	Rhea	inf.	n.
—	9·2	Tethys	sp.	
—	12·0	Encel	sf.	
—	16·3	Tethys	sf.	
15	13·9	Mimas	sp.	
—	14·3	Encel	sp.	
—	15·0	Tethys	np.	
16	9·4	Dione	inf.	n.
—	12·5	Mimas	sp.	
—	13·3	Encel	np.	
—	13·6	Tethys	sf.	
—	15·0	Rhea	sup.	s.
17	12·3	Tethys	np.	
—	15·7	Encel	nf.	
—	18·3	Dione	sup.	s.
18	10·9	Tethys	sf.	
—	14·7	Encel	sf.	
—	21·2	Rhea	inf.	n.
19	9·6	Tethys	np.	

1879.	Gr. M. Time. h.			
Aug. 19	17·0	Encel	sp.	
20	11·9	Dione	sup.	s.
—	16·0	Encel	np.	
21	18·3	Encel	nf.	
—	20·8	Dione	inf.	n.
22	10·7	Encel	sp.	
—	17·3	Encel	sf.	
—	21·1	Tethys	nf.	
23	9·5	Rhea	inf.	n.
—	9·7	Encel	np.	
—	14·1	Mimas	nf.	
—	19·6	Encel	sp.	
—	19·7	Tethys	sp.	
24	12.1	Encel	nf.	
—	12·7	Mimas	nf.	
—	14·4	Dione	inf.	n.
—	18·4	Tethys	nf.	
25	11·1	Encel	sf.	
—	15·7	Rhea	sup.	s.
—	17·0	Tethys	sp.	
26	13·4	Encel	sp.	
—	15·7	Tethys	nf.	
27	12·4	Encel	np.	
—	14·3	Tethys	sp.	
—	21·2	Tethys	sf.	
—	21·9	Rhea	inf.	n.
28	12·9	Tethys	nf.	
—	14·7	Encel	nf.	
—	16·9	Dione	sup.	s.
—	20·1	Tethys	np.	
29	11·6	Tethys	sp.	
—	13·7	Encel	sf.	
—	18 7	Tethys	sf.	
30	10·2	Tethys	nf.	
—	16·0	Encel	sp.	
—	17·4	Tethys	np.	
31	10·6	Dione	sup.	s.
—	15·0	Encel	np.	
—	16·0	Tethys	sf.	
Sept. 1	10·2	Rhea	inf.	n.
—	14·6	Tethys	np.	

VARIABLE STARS, AUGUST, 1879.

Approximate times of minima and maxima, according to Schönfeld and Winnecke.

1879.	G.M.T. h.			mag.	R.A. h.	m.	s.	1855. Decl. °	′
August 1	16·3	Algol	min.	4	2	58	45	+ 40	23·6
4	13·1	Algol	min.	4					
5		S Ursæ Maj.	max.	8	12	37	35	+ 61	53·3
7	10·0	Algol	min.	4					
10	6·8	Algol	min.	4					
13		S Vulpeculæ	max.	9	19	42	27	+ 26	55·7
14	17·1	λ Tauri	min.	4	3	52	39	+ 12	4·6
18	16·0	λ Tauri	min.	4					
19		S Herculis	min.	12·5	16	45	18	+ 15	11·4
22	14·8	λ Tauri	min.	4					
23		R Delphini	max.	8	20	7	55	+ 8	39·1
24	14·8	Algol	min.	4					
26	13·7	λ Tauri	min.	4					
27	11·6	Algol	min.	4					
28		S Delphini	max.	8·5	20	36	24	+ 16	34·2
—		V Tauri	max.	9	4	43	39	+ 17	17·4
30	8·4	Algol	min.	4					
—	12·5	λ Tauri	min.	4					
—		R Draconis	min.	?	16	32	17	+ 67	3·5
—		S Cygni	max.	9	20	2	28	+ 57	34·2
—		R Vulpeculæ	min.	13	20	57	56	+ 23	14·9

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec., 1878.
Horne & Thornthwaite, Messrs.

To June, 1879.
Gibson, J.
Horner, Rev. J.
Down, E.

To Sept., 1879.
Gray, J. P.

To Dec., 1879.
Remington, Major

To June, 1880.
Howlett, Rev. F.

To July, 1880.
Harcourt, J.

TO CORRESPONDENTS.

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The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON, 11, *Angel Court, Throgmorton Street, E.C.*, **not later than the 30th of the Month.**

The Astronomical Register.

No. 201. SEPTEMBER. 1879.

HYGINUS N.

By E. Neison.

During one afternoon in the beginning of April last year, I was in the library of the Royal Astronomical Society, and talking over the prospects of the newly-founded Selenographical Society. with Messrs. Sadler and Marth, and I think Mr. Common and Father Richards. The newly-published first number of the *Selenographical Journal* lay before us, and I was urging the importance of starting in its pages some subject of striking interest, so as to draw the attention of astronomers to the existence of the new society, and the advantage it promised to be to the science to which we were all devoted. Various suggestions were made, for I think my views were in entire accordance with the opinions of the others who were present, and in particular the subject of Linné was raised. My recollections of astronomy extended as far back as this period, and I well remembered how the astronomical world was electrified by the report of the disappearance of the crater. Nearly every astronomer was led to study the moon, and for months all the principal telescopes of Europe were turned upon our satellite. Moreover, many of our present amateurs were then for the first time led to purchase telescopes, and take up the study of astronomy. I do not think that any of us then anticipated that another such case of supposed change would be again discovered, at least, not for many years, for it was only reasonable to suppose that changes on so large a scale would occur at rare intervals, and most of us knew that it was only in probably small portions of the lunar surface where they would be recognised even if they did occur.

At this moment a letter, or rather a small book-post packet, was brought in to me, bearing a German post-mark, and on opening it I found it to be a small weekly astronomical periodical called the *Wochenschrift für Astronomie*, and dated March 27, 1878. It was the first time I had seen this German periodical, and I hastily glanced through it. On the middle page I found an article headed "Remarkable changes on the Lunar Surface," by Dr. Hermann J. Klein, and dated Köln, March 17, 1878. Thinking that it was an account of the supposed changes in Linné, Messier, &c., I did not look through it, intending to read it later on, one or two of our party being about to leave. The arrival of this paper has always struck me as being a remarkable coincidence, for it contained the first announcement of the existence of the new object, Hyginus N, discovered by Dr. Klein.

At this period my time was much occupied, so much so that I had scarcely a minute of leisure. It is, therefore, quite possible that I might have put aside for two or three days the *Wochenschrift für Astronomie* and then entirely forgotten it, in which case, not improbably, Dr. Klein's announcement would have remained practically unknown in England, and its importance never have been properly recognised. This, however, was not to happen.

Just before leaving the Society's rooms, Mr. Wesley brought me a letter addressed to the Secretary of the Royal Astronomical Society. It was from Dr. Klein, and related to some business connected with the Society. Incidentally Dr. Klein referred to his discovery of a new object near Hyginus, and he enclosed a rough tracing showing the position of the new crater. In most societies, in ninety-nine cases out of a hundred, a letter such as this would have gone through the usual routine, the business portion would have been answered and the rest would have been forgotten, and the whole carefully put away and never seen again. An exception was made in this case, perhaps because of the tracing. Mr. Ranyard, to whom the letter had been forwarded, gave directions that it was to be sent on to me. I received it, as already stated, just as I was about to leave the library, and on opening it saw the tracing. I confess it gave me a start, for there I saw figured, to the north of Hyginus, a great black crater in a region where I was positive no such crater existed. This part of the moon had been perfectly familiar to me for years, my first drawing dating eight years back. I knew no such crater could have existed there when I made my observations without my having seen it. For half a second I thought it might be some other crater misplaced, owing to imperfect drawing, but as a moment's reflection convinced me that there was no such crater to misplace, and a further glance showed me that all the other

features were tolerably well placed. Turning, I handed the tracing to Mr. Sadler, saying, "Look, Sadler, here is a new Linné."

Recollecting the article in the *Wochenschrift für Astronomie*, I instantly took it out, for I now attached a very different meaning to the heading "Remarkable changes on the Lunar Surface," and a glance showed me that it was an account of the extraordinary new crater shown on the tracing. In this account Dr. Klein states that on May 19, 1877, he saw, to the north of Hyginus, a great black crater, without a wall, but full of shadow, in a region where he was certain no such object had previously existed.

The article went on to state that on June 18 the new crater was visible only as a large black spot, surrounded by a vaporous border, but that on the 19th it had *disappeared*. From that day to November 13th the crater could not be seen because of the bad weather. On November 13th, 1877, it was seen as a dusky spot, but on November 14th it had disappeared, whilst on December 13th all that could be seen was a round dullish spot, scarcely visible. Lastly, on March 8th, 1878, the crater was completely invisible.

This account of the observations was not promising, and led me to think that Dr. Klein had made some remarkable error in his observations of May 19th, 1877. I knew from my own experience that no such crater existed in this region up to 1876, so that if Dr. Klein had really seen one where he described, and was not in error, it must have been formed since that epoch. Mr. Sadler and myself went over every drawing, representation, or photograph of this region we had access to. We closely examined the maps of Lohrmann and Mädler, then the photographs by Rutherfurd, De La Rue and Draper, the Melbourne photograph, Mr. Common's photograph. Next Schröter's drawings were scrutinized, and Gruithuisen's sketches hunted through. Further, we examined the drawings by Gaudibert, and the photographs of the drawings made with the great reflector of Lord Rosse. Lastly, we carefully went through all the miscellaneous drawings to be found in the library of the Royal Astronomical Society. Not a trace of this crater was to be found in one of them.

I was not surprised at this result, for my own observations had convinced me that no such object as depicted by Dr. Klein could have escaped being seen by me if it had existed prior to 1876, and being incredulous about it being a real change on the surface of the moon, I was of opinion that probably there must have been some error on the part of Dr. Klein in his first observation. However, it was decided that the best thing to do would be for Mr. Sadler to forward an account of the observations to the

English Mechanic, whilst I wrote to some fifteen or twenty astronomers, who were correspondents of mine, and who were more or less accustomed to observe the moon. At the same time I put myself in communication with Dr. Klein.

It is unnecessary to detail the further steps which were taken by the Council of the Selenographical Society, in order to secure observations of the supposed new crater Hyginus N. The whole of the members of the society were put on the alert, and by means of the foreign secretaries of the society, the Colonial and American astronomers were duly warned. Under any ordinary circumstances three months would have conclusively settled the point. If this new object, Hyginus N, was a deep black conspicuous crater, three miles in diameter, as it was stated to be by Dr. Klein, I had not the slightest doubt but that it must be new, feeling certain that I could not have overlooked it. Moreover, it seemed to me incredible that either Mädler or Lohrmann could have overlooked it, for my comparison of this portion of their maps with the moon has shown me how carefully they had worked, and how exceedingly complete they were. Of course had the supposed new crater been smaller, or placed in a rugged region, I should not have been so confident. But it seemed incredible to me that, in the case of a crater so favourably placed, they could have passed it over and yet seen numerous much smaller objects all around it.

Unfortunately a most extraordinary spell of bad weather set in, lunation after lunation went by without its being possible to observe the moon at either its first or third quarter. The few isolated observations which did come in were most perplexing in their nature. Not only were they irreconcilable with the observations of Dr. Klein, but they were irreconcilable with each other, nay, some were irreconcilable with anything else on the surface of the moon, and seemed to be endowed with marvellous properties irreconcilable with each other. To a certain extent this may have been due to the fact that they were mostly made by observers unfamiliar with lunar work. What was most perplexing of all was the remarkable discrepancy in the place assigned to this new crater; no two sketches agreed, even though made by the same hand, until the final climax was put to the matter by my receiving a set of drawings showing the new crater, as if it were steadily marching across the moon at the rate of ten miles an hour.

Almost immediately after the general attention of astronomers had been directed to the supposed new crater, it began to be announced that it could not be new because it was plainly visible in various photographs of the moon, taken long prior to the date of its supposed discovery by Dr. Klein. Some could recognise it as

a white spot on the photograph, and others could distinguish it as a black spot; some could see it in one place, others in another. This was an entire mistake, and arose partly from not knowing the exact position of the new crater, and partly from being unaware that there were numerous other light and dark markings on the moon, which could not be distinguished on the photographs from the supposed new crater. What ought alone to have shown them their error was the fact that Dr. Klein had found his crater to disappear completely when the lunar terminator was in —20° long., whilst when these photographs were taken the lunar terminator was still greater, so that the crater must then have been completely invisible. It is true that it was urged that a photograph might show an object invisible to the eye, but as a matter of fact there is no lunar feature portrayed on any photograph which cannot be most distinctly seen with a very small telescope.

Gradually as the observations accumulated it became possible to throw fresh light on the subject, and to separate the numerous observations into different classes, especially into observations of Hyginus N, and observations of something mistaken for Hyginus N. Some, indeed, of the observations which reached me had been made at a time when not only N, but Hyginus itself, had long vanished into darkness, and yet both were shown—obviously some other point had been mistaken for Hyginus. In particular were we indebted to Dr. Klein. He was not likely to mistake anything else for Hyginus N, and all his observations were wonderfully consistent with each other. It began to be evident that some of the observers had confused the crater with the dark spots on the surface which I had long known to exist, and which were laid down on my maps of 1874 and 1876.

Finally, a series of fine nights in the spring of this year enabled me to observe the region and rendered everything plain. For a considerable period I had rather inclined to the view that subsequent observations would show Hyginus N to be smaller and far less conspicuous than Klein had imagined from his early observations. If this view turned out to be correct it was not impossible that N might have existed for years, and have been merely overlooked. I thought it not improbable that it might lie close under the shadow of a mountain or hill, and so readily escape notice. My observations have conclusively shown that this view was not correct, for N is so distinct and conspicuous, that it is impossible to suppose that it might have been overlooked in any such matter. If Hyginus N was as distinct as it is now, in 1780—1795, when Schröter observed, when Gruithuisen observed in 1815—1826, when Lohrmann observed in 1824—1830, when Mädler observed, 1830—1839, and during the later periods when observed by

Schmidt, Klein, and myself—then I cannot account in any manner whatever for its being overlooked.

I now propose to examine in more detail the knowledge we possess on this subject, and to endeavour to lay down the evidence in favour or against the view that Hyginus N is a new formation.

From the observations which have now been made, it would appear that the new crater has the appearance of a great black object when the lunar terminator is between $+7°$ and $+0°$ longitude, but that when the lunar terminator lies between $+7°$ and $+5°$ it is partially in shadow, whilst when the terminator lies between $-0°$ and $-10°$ the new crater appears like a dark spot. At the early portion of this period it is very distinct, later on it becomes much less conspicuous. When the lunar terminator is beyond the 30th meridian of east longitude, the crater is no longer visible.

I now propose to examine the observations of this region in my possession, made between 1869 and 1877 at times when the new crater ought to have been visible.

1870, July 5. Terminator $+2°$. Schmidt. Hyginus N not seen.

1871, Feb. 26. Terminator $+7°$. Gaudibert. The region round Hyginus N may not have been observed.

March 28. Terminator $+4°$ to $+2°$. Schmidt. No trace of Hyginus N.

April 27. Terminator $-4°$ to $-5°$. Neison. No trace of Hyginus N. Indifferent sketch.

May 26. Terminator $+2°$ to $+0°$. Neison. No trace of Hyginus N.

June 25. Terminator $-5°$ to $-6°$. Neison. Splendid definition. No trace of Hyginus N.

Neither was there on June 26, when the definition was still better. Nor was it visible on Sept. 22, Oct. 21, nor Nov. 20.

September 6. Terminator $+12°$ to $+10°$. Gaudibert. Evening illumination. No trace of Hyginus N, although the region is very carefully drawn.

December 2. Terminator $+21°$ to $+19°$. Neison. Evening illumination. Hyginus N not seen.

December 19. Terminator $-4°$ to $-6°$. Neison. Hyginus N not seen.

1872, January 18. Terminator $-8°$ to $-9°$. Neison. Hyginus N not seen. On this night the whole region was carefully measured.

March 16. Terminator $+8°$ to $+6°$. Neison. Hyginus N not seen. Bill very distinct.

June 13. Terminator $+1°$ to $-1°$. Neison. Hyginus N not seen. Definition not very good.

From August 23rd, 1871, to September 7, I made a great number of observations of this region, in which no less than four dark spots close to Hyginus were examined on every day which was possible. Had there been any dark spot in this region gradually becoming lighter it could not well have escaped my detection, for it was in the search for such a spot that I was actually engaged. The only two which do exhibit even a slight change of this nature were detected and closely watched for over two years. The details of these numerous observations cannot be given here, the results have already appeared in the *Astronomical Register* some four or five years ago. The present list is kept to special observation made with the view of detecting craters, and other detail not in Beer and Mädler's map.

December 7. Terminator $0°$ to $-2°$. Schmidt. Hyginus N not seen.

1873, June 2. Terminator $+4°$ to $+2°$. Schmidt. Hyginus N not seen.

1874, January 24. Terminator $+6°$ to $+5°$. Neison. Hyginus N not seen. Definition fair.

January 25. Terminator $-5°$ to $-7°$. Neison. Hyginus N invisible. Definition very fine, and many new objects detected, including the very delicate winding rill Ukert η. The whole region was very carefully examined.

April 23. Terminator $+2°$ to $+1°$. Neison. Hyginus N not seen. Fine definition. M. Gaudibert seems to have made a drawing on the same night, but does not show N.

June 21. Terminator $+2°$ to $+1°$. Neison. Hyginus N not seen.

December 15. Terminator $+3°$ to $+2°$. Neison. Hyginus N not seen.

1875, March 14. Terminator $+1°$ to $-1°$. Schmidt. Hyginus N not seen.

August 8. Terminator $+5°$ to $+3°$. Schmidt. Hyginus N not seen (dated Aug. 13, probably through an error).

During the year 1875 and early part of 1876, I gave up making special drawings of the moon, and confined myself to carefully comparing my map with the actual surface, inserting where necessary the new objects which were detected, and rectifying where necessary the errors in the delineation of the surface. On some eighteen or nineteen nights I carefully went over the district

between Agrippa, Rhœticus, Bode and Manilius, a region which has Hyginus in its very centre. On some of these occasions the sun was high, and then N would have been invisible. The only record that I possess of these observations is comprised in the alterations made on the draught maps I was comparing with the moon. Further information, it is true, might be obtained by wading through the enormous mass of notes, observations, and measures which I accumulated when engaged on my work on the moon, but this is hardly practicable. From the notes I have I find that this region when near the terminator was observed on the following days. The duration of the observation on each day is quite uncertain.

1875, March 14. Terminator +2° to +1°.
April 12. Terminator +8° to +6°, and next day terminator —3° to —2°.
May 12. Terminator +2° to +1°.
July 10. Terminator +1° to 0°.
August 22. Terminator +14° to +12°. Evening illumination.
September 7. Terminator 0° to —1°.
October 20. Terminator +13° to +12°. Evening illumination.
December 5. Terminator —4° to —5°.
1876, February 2. Terminator —2° to —3°.

During these observations I detected a number of very small craters and some small rills and hills in the very neighbourhood of the new object N, so that it could not well have been overlooked if it had been then as conspicuous as now.

During the latter part of 1876 and the whole of 1877 my observatory was dismantled, and as my whole time was taken up by other matters, no lunar observations were made.

From the preceding list it appears that this portion of the moon was most carefully observed on no less than twenty occasions, when Hyginus N should have been visible as a great black crater-like object, so conspicuous as to have been almost the most distinct object in this region. Yet it was never seen, though many much more minute and less distinct objects were seen and even discovered. These twenty occasions do not include fourteen or fifteen occasions when I was engaged on my tint determinations, and searching this very locality for every dark spot which showed any marked variation in brightness. Yet if Hyginus N, with its great change in brightness, had then existed it is difficult to conceive that I could have overlooked it. The preceding list also contains nine occasions when this region was

closely examined, and when Hyginus N ought to have been distinctly visible as a greyish black spot, yet it was never seen. It would be difficult to find stronger negative evidence. They seem to me to be conclusive proof that between the years 1870 and 1876 there did not exist in this region a great black crater-like object three miles in diameter, and one of the most conspicuous objects in the entire region, as Hyginus N is declared now to be.

It remains to examine the observations which have been made since the discovery by Dr. Klein of the supposed new crater N. This I now proceed to do in some detail, as the importance of the subject well merits.

1877, May 19. Terminator + 4° to + 2°. Klein. Hyginus N appeared like a large black crater filled with shadow, but without a wall. The definition was not good, and only one of the small neighbouring craters could be seen, so that the new object must have been very conspicuous to have been seen.

1877, June 2. Terminator + 11° to + 9°. Schmidt. Dr. Klein seems to have at once written to Herr Julius F. Schmidt, the great Athenian selenographer and an old correspondent of his, for on this night Schmidt examined the moon under evening illumination and at once saw the crater.

1877, June 18. Terminator — 1° to — 2°. Klein. The definition was bad and the moon low and past the meridian. The small craters in the plain north-west of Hyginus were distinctly seen, and N appeared like a large black spot with a nebulous border. It seemed to contain a darker nucleus.

1877, June 19. Terminator — 14° to — 15°. Klein. Hyginus N could not be detected although the smaller craters to the north-west of Hyginus were still visible. In the place of the crater was a large dull grey spot.

1877, July 19. Terminator — 20° (about). Schmidt. According to Klein, the new crater was seen for the second time by Schmidt on this night, but he does not say in what form. I think that there is probably some error in the date, and that the 17th is intended.

A long interval of bad weather seems to have prevented any observation between July and November. Neither Schmidt nor Klein obtained a chance of seeing the moon under proper illumination, nor can I learn of any observations having been made in England during this period.

1877, November 13. Terminator — 7° to — 8°. Klein. The air was tolerably steady, and Hyginus N was seen at the first glance as a large spot with an ill-defined border, and about three miles in diameter.

1877, November 14. Terminator — 20° to — 21°. Klein. Not a trace of N could be detected though definition was very good.

1877, December 13. Terminator — 12° to — 13°. Klein. The lunar surface was exceptionally clear and distinct, but all that could be seen in the place of Hyginus N was a round indistinct spot, scarcely distinguishable from the surrounding surface.

1878, February 9. Terminator + 1° to — 1. Schmidt. Hyginus N very distinct.

This was the last observation which was made previous to Klein publishing an account of his observations. They show that when the terminator lies between + 5 and 0 longitude, that is, when the sun has an altitude of from 3° to 8° above the horizon of the plain north-west of Hyginus, then Hyginus N appears like a very conspicuous black spot, far more distinct than the surrounding craterlets. As the terminator advances from 0° to —10° longitude, or the solar altitude increases from 8° to 17°, the spot rapidly decreases in darkness until it appears like an indistinct blackish-grey spot, which in turn completely disappears when the terminator has advanced to about —20°, or the solar altitude is about 26°. According to Klein, it remained invisible as long as the solar altitude exceeded 26°, a most important conclusion, for, as already remarked, it proves that the crater cannot be visible on the Rutherfurd or Melbourne photographs, both of which are taken when the sun is still higher on this region.

(To be continued.)

A BI-CENTENARY.

1679, SEPT. 26.

If centenaries are to be kept, it may be worth remembering that in a few weeks two hundred years will have elapsed since the occurrence of the catastrophe by which brave old Hevelius was nearly overwhelmed. Readers, who do not object to give some thoughts to such an old story and its lessons, will, probably, like best to read Hevelius' own account of the calamity and of the state of mind into which he was thrown thereby. The following extracts are taken from the preface of his "Annus Climactericus," 1685. It may be premised, that in the summer of 1679 Hevelius had several special causes for satisfaction. The

second part of his "Machina Coelestis," the bulky folio containing the observations, which he had accumulated with such great toil and trouble during so many years, had been printed off and the copies were ready for publication. Though the instruments, with which these observations were made, had not the advantage of being provided with telescopes, and Hevelius persisted in the use of plain sights, he managed by great dexterity to measure the distances of stars with surprising accuracy, and he had now Halley as a witness to state the facts. Young Halley had come from London by sea to Dantzick on May 26, had been Hevelius' guest for nearly two months, had witnessed and taken part in the observations, and was now able to report to the Royal Society the results of his personal experience. Hevelius was well pleased with the visit.

" . . . . . quanto felicior ineunte Anno 1679 ac etiam per plurimos subsequentes Menses fuerim, ... tanto profecto infelicior etiam extiti circa ejusdem Anni exitum: adeo ut pene omnem spem omnino abjecissem, vel quicquam amplius in Rebus Astronomicis tentandis, nedum peragendis, sive ea, quae jam parata, Divino auxilio, habebam, ulla aliqua via, sub Astrosophorum oculis, me posse subjicere.

"Nam, cum die 26 Septembris st. n. ejusdem dicti anni, immane et atrocissimum illud infortunium, ex proposito et summa malitia bipedum nequissimi cujusdam hominis, et quidem mei famuli mihi acciderit, ut nefandis ignibus (id quod privato cuidam sicuti mihi, ea ratione, quantum sciam, haud unquam forte obtigit) aedes meas numero septem, cum omnibus meis in iis existentibus rebus, nummis, auro, argento, omnique prorsus supellectile, Typographiis, magna parte Bibliothecæ, omnibusque Operibus, ab Anno 1647 ad Annum 1679 sumptibus meis editis, cum pretiosissima mea Urania, Specula, cunctisque Organis, tam Astronomicis, quam Opticis, in Machinae meae Coelestis Parte Priori descriptis ac delineatis, alia quam plurima pretiosa, ut modo taceam, penitus perdiderim; atque ita unius, aut alterius horulæ spatio, omnibus fere meis substantiis, et facultatibus exutus omnio fuerim, facile, mi Lector, colligere datur, quomodo talis insperatus, subitaneus, horrendus ac tristissimus casus, aliquem etiam longo animosiorem prosternere, circulosque ejus omnimodo conturbare valeat. Sic ut mirum haud fuisset, me, ex immani ista consternatione, ac subsecutis curis, sollicitudinibus et afflictionibus, imprimis dum mihi in memoriam revocarem, quaenam possederim, quaenam perdiderim, quorum plurima nunquam reparare, ac recuperare valerem, in illo ipso momento ad operas omnes incapacem prorsus redditum fuisse, imo ipsam vitam derepente cum morte commutasse.

"Sed DEO Omnipotenti, cujus Gratia et Misericordia est infinita, unice referendum habeo, quod me in isto ineffabili infortunio adhuc vivum, sanum, inprimis mihi corporis animique, in conturbatissimo illo meo statu, ubi omnia funditus diruta, atque in cineres omnino redacta jacebant, nec non ab omnibus maximis, atque innumeris illis aeneis Organis, ac pretiosissimis Telescopiis vix unum et alterum frustulum reliquum esset, benignissime conservaverit . . . . ."

On Sept. 26, at noon, Hevelius had observed the azimuth and zenith distance of the sun "incomparabili illo magno Quadrante Azimuthali Orichalcico." He had then left the town for his country-house in the neighbourhood. The destruction of his seven houses with almost all the property they contained took place while he was absent. The shock to him was almost overpowering, as his words sufficiently testify. He was then already in his 69th year. When he regained his composure, he bravely struggled with his many difficulties, succeeded in building another observatory, and furnishing it with the necessary instruments, and resumed his observations. But the blow had been too great, and he recovered from it only partially. He died seven years after the catastrophe.

A. M.

THE LICK OBSERVATORY.

Mr. S. W. Burnham writes from Chicago, on the 28th July, to say that he expects to start in the course of a few days on an Expedition to California, to report on the relative merits of the various stations proposed for the Lick Observatory. He takes with him a six-inch Alvan-Clark, with driving clock and other necessary attachments, and expects to be absent some two or three months.

REVIEWS.

Obituary Notices of Astronomers, Fellows, and Associates of the Royal Astronomical Society. Written chiefly for the Annual Report of the Council. By Edwin Dunkin, F.R.S., F.R.A.S., of the Royal Observatory, Greenwich, Honorary Secretary of the Royal Astronomical Society, 1871—1877. Williams and Norgate, London. pp. 257. Price 6s. 6d.

Biography in the present day is overdone, and it is therefore pleasant to read such a nice little volume as Mr. Dunkin has given us, with its pleasing and judicious notices of twenty-four astronomers. We wish we had a *cyclopædia* of such well-written sketches. It is one of the benefits conferred by the Royal Astronomical Society that its fellows and associates of any note have such memorials when they pass away; even though some of them may have been only slightly connected with astronomy. It is possible, however, to deserve well of the science, even in a humble

way. Nineteen of these biographical sketches were contributed to the Council's Reports from 1872 to 1878. Much more space is of course given to the notices of men such as Delaunay, the Herschels, Le Verrier, and the Rev. Robert Main. The memoirs of the Herschels are almost new, and that of Le Verrier is considerably enlarged from what appeared in the *Observatory* for October, 1877.

British Rainfall, 1878. On the Distribution of Rain over the British Isles during the year 1878, as observed at about 2,000 stations in Great Britain and Ireland, with a description of all known forms of self-recording rain gauges. Compiled by G. J. Symons, F.R.S., Secretary of the Meteorological Society, &c., &c. London, Edward Stanford, Charing Cross. pp. 168. 5s.

Here is Mr. Symons's elaborate annual volume again. The very laborious work of himself and his two assistants is something out of the common. May he be long spared and encouraged to go on with it. He observes that the volunteer observers of this country keep up a system of rainfall registration which has no equal in the world. Besides the usual matter, this volume has a paper, with illustrations, on self-recording rain gauges. We learn that in the severe thunderstorm in London of June 23rd, in 58 minutes there fell 3·28-inches of rain; in 10 minutes, 1-inch, and a maximum rate was attained of a tenth of an inch in 30 seconds, which is equivalent to 12 inches per hour. This was recorded at Camden Square with Pastorelli's storm rain gauge. The extremes of rainfall in 1878 were, at the Stye, in Cumberland, 149·04-in., and at Keadby, in Lincolnshire, 17·35-in. The obituary list for the year contains the names of fifty observers, involving, besides other serious losses, that of £25 off the subscription list. It is superfluous for us to recommend to readers of all descriptions this excellent work.

Annual Report of the Director of Harvard College Observatory. Presented to the Visiting Committee November 14, 1878. By Professor Edward C. Pickering. Cambridge: Press of John Wilson and Son. 1879.

Photometric, meridian-circle, and other observations continue to be zealously prosecuted in this observatory, the efficiency of which, we rejoice to find, is likely to be increased by the efforts of the Visiting Committee in starting a subscription. Professor Pickering at the close of his report says—"Both telescopes have been in constant use, the distribution of standard time has been extended, and much progress has been made in the reduction of past observations; but the present income of the observatory will not permit this rate of work to be maintained. An increase of 5,000 dollars a year for five years has been solicited, and if obtained will, during that time, more than double the scientific results of the observatory, whose endowment, grounds, buildings, instruments, and library required a sum of more than 300,000 dols. But little remains to be promised in order to secure the whole. If this can be done, rapid progress can be made in the publication of the accumulated mass of past observations, which are in danger of destruction by fire so long as they remain unprinted; and an activity can be maintained throughout the institution commensurate with its reputation at home and abroad."

The Testimony of the Stars to the Truths Revealed in the Bible. Abridged from the late Miss Frances Rolleston's "Mazzaroth; or, the Constellations." By Caroline Dent. Rivingtons, London, 1879. Pp. 39.

Many have been interested in Miss Rolleston's original work; and this concise epitome seems well adapted to bring the subject before a larger

circle of readers. We learn from the preface that some such abridgment was contemplated by the author, who however did not like to make it. This little work has our best wishes, and its editor our best thanks.

Report of the Kew Committee for the year ending October 31, 1877. pp. 18.

The report alludes with heartfelt regret to the decease of Mr. J. P. Gassiot, one of the most active members of the Committee since 1851, who had devoted much time to the Kew Observatory, besides endowing it with a large sum. After notices of magnetic and meteorological work, under the head of *Photoheliograph*, we learn that the re-examination of the measurements of the Kew sun-pictures has been carried on by Mr. Whipple, but the enormous number of spots in the maximum year, 1870, has caused the past year's progress to be rather slow. On several days more than 150 spots have had their positions determined. These operations have been conducted at the expense of Mr. De La Rue. Eye-observations of the sun have been daily made, when possible, by Mr. Harrison, after the method of H. Schwabe, in order to maintain the continuity of the Kew record of sun-spots. Many instruments have been verified and tested. General Sir E. Sabine, K.C.B., is Chairman of the Committee, and Mr. De La Rue, Vice-chairman. The staff employed at Kew are Mr. G. M. Whipple, B.Sc., Superintendent, J. W. Baker, first assistant, and nine other gentlemen. After the financial statement, the appendices contain tables of magnetic and meteorological observations. Kew is the central observatory of the Meteorological Office. At the request of the Editor of the *Times*, a copy of the traces of the self-recording instruments on a reduced scale, together with an epitome of the general features of the weather, is now prepared. This is published every week in that journal, the cost to the observatory being defrayed by the proprietors. It is gratifying to find that this valuable and important observatory continues in vigorous operation.

Report of the New Jersey State Commission appointed to devise a plan for the encouragement of manufactures of ornamental and textile fabrics. 1878. pp. 90. Trenton, N.J.

Though not properly finding a place in the columns of an astronomical serial, we must yet devote a few lines in praise of this able document. It reviews the technical schools and colleges on the Continent and in this country, and condenses a great amount of valuable and interesting information. The Commissioners, Messrs. Samuel C. Brown, Thos. N. Dale, and Robert H. Thurston (Secretary), appear to have admirably fulfilled their duties. We transcribe the following: "Despite the non-utilitarian idea of so many among the early Greek philosophers, the great Alexandrian Museum, founded three centuries before Christ, was made, so far as it was possible in those early days, a technical school, and the principles of science there taught were, for centuries, of direct value in the encouragement of the growth of all the then known industries. Ptolemy and other astronomers taught seamen the motions of those stars upon which they relied for guidance. Archimedes and other engineers of that time were at the same time philosophers and mathematicians, and every art, whether of war or peace, had its representative practitioners among the attendants at that great seat of learning. The Roman and Saracen universities and schools, of still later times, were not wholly 'gymnastic' and non-utilitarian in character, and the arts often received new developments and were frequently given a new impetus by those discoveries of the philosophers and schoolmen which were promulgated by the investigators themselves, or by their disciples,"—p. 26. We then come to the Marquis of Worcester and Descartes, and to the times following.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.
To all communications must be annexed the name and address of the sender, as a guarantee of good faith.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

PERSONAL REMINISCENCES OF A LABOURER IN SELENOGRAPHY.

It is more than twenty years since I first turned a telescope of less than 3-inches aperture on the moon, and was much interested with the appearances presented by the broken surface of our satellite, but I had something more in view than the mere gratification arising from the contemplation of the varied aspects of such portions of the disk that were coming into sunlight, and those on which the sun had been shining for many hours, and even terrestrial days. An old proverb says, "If a thing is worth doing at all, it is worth doing well," and in accordance with it I determined to turn to some account, if possible, my moon-gazing. Among the multiplicity of interesting objects presented to my attention it was difficult to fix my choice, and consequently I abandoned myself to study such as might of themselves attract my notice. One of these was the more or less regularly formed *Mare Crisium*, the surface of which especially interested me. About this time the charming and useful little book of the Rev. T. W. Webb, "Celestial Objects for Common Telescopes," had just been given to the astronomical public, and I adopted, as my *vade mecum*, the excellent index map with which it is illustrated. It was on the surface of the *Mare Crisium* that I noticed a spot that was not on the map, as well as on the *Mare* then known as *Picard*. *Picard* A and B were easily recognised, but the spot seen by me, which was quite as distinct and rather larger than *Picard*, had certainly not been included amongst the objects recorded, nor was it to be found on the much larger map of Beer and Mädler. Here, then, was some good work in prospect. The spot was certainly, as seen at that time, very different from a crater, it was more like a *cloud*, a *whitish cloud*. It was accordingly kept steadily in view, and it was only by a careful record of its appearances from time to time that it became invested in after years with sufficient interest to attract the attention of other observers. It is now known as "the white spot west of *Picard*." A history of this spot, compiled from notices of its appearances, both printed and in manuscript, would throw some light on the much agitated question, "Are changes taking place on the moon's surface?"

Another reminiscence of the writer of this article is that of the celebrated case of the crater *Linné*. The facts were so fully submitted to astronomers about twelve years ago, that it is unnecessary to refer to them here, and I believe that a somewhat extensive change in the size and character of the crater previous to October, 1866, is still questioned; suffice it to say that although "a hue and cry" was on foot which extended over Europe, the question still awaits settlement, and it would be well if selenographers of the present day were to attack this subject as *de novo*, carefully describing the appearances presented by the object, measuring at stated intervals the size of the orifice, and examining the features which *Linné* possesses now, with the view of ascertaining if they accord with those recorded in 1866 and 1867. Although much has been effected of late years, *Linné*, appears to have been forgotten.

Perhaps the reminiscence that the writer cherishes most is that calling to mind the examination of the floor of *Plato*. The observations of its spots and streaks, the determination of their variations of visibility, and the attempt to ascertain the circumstances affecting the frequency of visibility of each, have been so fully detailed in the years 1871 and 1872, that a series of observations of the same kind, executed with the same care, discussed in the same manner, or in any other that future observers may decide upon, could not fail of throwing some light on the question suggested in the course of the observations 1869—1871. It is the repetition of observations and their examination at intervals of several years that contribute greatly to the advancement of our knowledge, for it is hardly likely that an object such as the floor of *Plato* should remain in *exactly* the same state during a period of eight or ten years.

The establishment of a Selenographical Club in the autumn of 1877, which merged into, or was rather succeeded by, the Selenographical Society, was a subject for congratulation to those who desired to see the study of the moon's surface taken up with spirit and energy. Its success has been equal to the anticipations of its promoters, and although the objects of study are taken up at present somewhat discursively, yet as time advances, and the number of its members increases, it is not unlikely that several of the larger formations, as Copernicus, Kepler, Aristarchus, Eudoxus, Aristoteles, Archimedes, and many others, will be selected for special study. The foundation of this mode of proceeding is already laid, and the prospect of an extensive harvest is cheering to those observers who have recently entered on their labours.

But I must draw these reminiscences to a close, the night is approaching, and the labourer must go to his rest, and leave the

further prosecution of the study of selenography to other and abler hands, and when he quits the field he desires to bequeath to his successors the results of his labours, many of which have been printed, but the greater part are still in manuscript. He looks forward with confidence that—when night shall overshadow him with its inevitable darkness, so far as this world is concerned—the knowledge of the configuration and condition of the *moon's surface* will proceed with an accelerated impetus, and the two cognate branches of research, Selenography and Selenology, will take their positions among the numerous subjects of human knowledge.

A SELENOGRAPHICAL LABOURER.

OCCULTATION OF ANTARES.

Sir,—Tho occultation of *Antares* on July 28th was well seen here with the 18-inch reflector. The disappearance at the dark limb of the moon was absolutely instantaneous. The reappearance was interesting from the singular way in which the star seemed gradually to disengage itself from the irradiation of the bright limb. There being a good deal of disturbance at so low an altitude, the effect was much the same as if an insect were struggling out of a spider's web, the time occupied being as much as five seconds.

The instant of reappearance was marked by a break in the continuity of the bright limb, the star actually becoming visible within the limb, and a very singular and excessive disturbance went on for five seconds, until the star was free, when it settled down into the ordinary scintillations of the star and the undulations of the moon's limb.

Stretton Rectory, Hereford:
August 7, 1879.

Faithfully yours,
HENRY COOPER KEY.

THE INNER SATELLITES OF SATURN.

Major and minor semi-axes of the apparent orbits of the satellites, expressed in semi-diameters of Saturn's equator.

		Mimas.	Encel.	Tethys.	Dione.	Rhea.
Major		3·14	4·03	4·99	6·40	8·93
Minor	Sept. 2	0·54	0·69	0·85	1·09	1·53
	„ 12	·52	·67	·83	1·06	1·48
	„ 22	·50	·65	·80	1·03	1·43
	Oct. 2	0·49	0·62	0·77	0·99	1·38

In these orbits the satellites move in the direction of decreasing position angles.

Approximate Greenwich times of some of the conjunctions of the satellites with the centre of the ball and the ends of the ring:

"inf." inferior conjunction with centre of ball, north.
"sup." superior „ „ „ „ south,

nf. Satellite in conj. with following edge of ring, north, moving towards the ball.

np. „ „ preceding „ „ away from „
sf. „ „ following south „ „ „
sp. „ „ preceding „ „ towards „

1879.	Gr. M. Time. h.				1879.	Gr. M. Time. h.			
Sept. 1	10·2	Rhea	inf.	n.	Sept. 16	9·9	Tethys	nf.	
	14·6	Tethys	np.			14·8	Mimas	sp.	
	19·4	Dione	inf.	n.		17·0	Tethys	np.	
2	6·2	Tethys	sp.			19·0	Encel	nf.	
	13·3	Tethys	sf.			20·5	Dione	sup.	s.
3	4·2	Dione	sup.	s.	17	8·5	Tethys	sp.	
	4·8	Tethys	nf.			11·4	Encel	sp.	
	11·9	Tethys	np.			13·4	Mimas	sp.	
	16·4	Rhea	sup.	s.		15·6	Tethys	sf.	
4	10·6	Tethys	sf.			18·0	Encel	sf.	
	13·1	Dione	inf.	n.	18	7·2	Tethys	nf.	
5	9·2	Tethys	np.		18	10·4	Encel	np.	
	10·1	Encel	sf.			12·0	Mimas	sp.	
	21·9	Dione	sup.	s.		14·3	Tethys	np.	
	22·6	Rhea	inf.	n.		18·1	Mimas	sf.	
6	7·9	Tethys	sf.		19	10·6	Mimas	sp.	
	12·1	Mimas	sf.			11·6	Rhea	inf.	n.
	12·4	Encel	sp.			12·7	Encel	nf.	
7	11·4	Encel	np.			12·9	Tethys	sf.	
8	13.7	Encel	nf.			14·2	Dione	sup.	s.
	14·5	Mimas	nf.			16·7	Mimas	sf.	
	15·6	Dione	sup.	s.	20	11·6	Tethys	np.	
9	12·7	Encel	sf.			11·7	Encel	sf.	
	13·2	Mimas	nf.			15·4	Mimas	sf.	
10	10.9	Rhea	inf.	n.	21	10·2	Tethys	sf.	
	11·8	Mimas	nf.			14·0	Encel	sp.	
	15·0	Encel	sp.			14·0	Mimas	sf.	
11	9·2	Dione	sup.	s.		17·7	Rhea	sup.	s.
	10·4	Mimas	nf.		22	7·8	Dione	sup.	s.
	14·0	Encel	np.			8·9	Tethys	np.	
12	9·0	Mimas	nf.			12·6	Mimas	sf.	
	15·1	Mimas	np.			13·0	Encel	np.	
	15·3	Tethys	nf.			17·8	Mimas	nf.	
	17·1	Rhea	sup.	s.	23	7·5	Tethys	sf.	
	18·0	Dione	inf.	n.		11·2	Mimas	sf.	
13	8·8	Encel	sp.			13·3	Encel	nf.	
	13·8	Mimas	np.			16·4	Mimas	nf.	
	13·9	Tethys	sp.			16·6	Dione	inf.	n.
	15·3	Encel	sf.		24	7·8	Encel	sp.	
14	12·4	Mimas	np.			9·8	Mimas	sf.	
	12·6	Tethys	nf.			14.3	Encel	sf.	
15	10·1	Encel	nf.			15·0	Mimas	nf.	
	11·0	Mimas	np.		25	13·6	Mimas	nf.	
	11·2	Tethys	sp.			16·7	Encel	sp.	
	11·7	Dione	inf.	n.		19·7	Mimas	np.	
	16·1	Mimas	sp.			20·3	Tethys	nf.	
	16·6	Encel	np.		26	9·1	Encel	nf.	
	18 3	Tethys	sf.			10·3	Dione	inf.	n.
16	9·1	Encel	sf.			12·2	Mimas	nf.	
	9·6	Mimas	np.			15·7	Encel	np.	

1879.	Gr. M. Time. h.		
Sept. 26.	18·4	Mimas	np.
	19·0	Tethys	sp.
27	8·1	Encel	sf.
	10·8	Mimas	nf.
	17·0	Mimas	np.
	17·6	Tethys	nf.
	18·0	Encel	nf.
	19·1	Dione	sup. s.
28	9·4	Mimas	nf.
	10·4	Encel	sp.
	12·2	Rhea	inf. n.

1879.	Gr. M. Time. h.		
Sept. 28.	15·6	Mimas	np.
	16·3	Tethys	sp.
29	9·4	Encel	np.
	14·9	Tethys	nf.
30	12·8	Dione	sup. s.
	13·5	Tethys	sp.
	18·4	Rhea	sup. s.
	20·7	Tethys	sf.
Oct. 1	12·2	Tethys	nf.
	19·3	Tethys	np.

The predicted times of the conjunctions of Mimas are considerably uncertain. It would be worth while spending time and trouble in observing some of these conjunctions. A. M.

THE PLANETS FOR SEPTEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension. h. m. s.	Declination. ° ′	Diameter.	Meridian Passage. h. m.
Mercury ...	1st	9 47 39	N.11 26	8″·9	23 2·8
	9th	10 6 49	N.12 7½	7″·0	22 50·4
	17th	10 51 54	N. 9 3	5″·7	23 3·9
	25th	11 45 16	N. 3 34	5″·1	23 25·7
Venus ...	1st	12 20 41	S. 9 25½	52″·3	1 39·3
	9th	12 15 37	S. 10 14	53″·2	1 2·8
	17th	12 2 38	S. 9 37	57″·6	0 18·4
	25th	11 43 34	S. 7 18	59″·1	23 24·0
Mars ...	1st	3 17 34	N.15 46	15″·6	16 33·7
	9th	3 29 14	N.16 36	16″·6	16 13·9
	17th	3 38 28	N.17 17	17″·6	15 51·7
	25th	3 44 46	N.17 49	18″·8	15 26·5
Jupiter ...	1st	22 39 4	S. 10 2½	46″·4	11 56·0
	9th	22 35 9	S. 10 26	46″·2	11 20·6
	17th	22 31 26	S. 10 48	45″·9	10 45·5
	25th	22 28 6	S. 11 7	45″·4	10 10·7
Saturn ...	1st	0 58 23	N. 3 20½	17″·5	14 14·9
	9th	0 56 38	N. 3 8	17″·6	13 41·7
	17th	0 54 39	N. 2 54	17″·8	13 8·3
	25th	0 52 28	N. 2 39½	17″·8	12 34·7
Neptune ...	14th	2 39 51	N.13 39½	...	15·5
	26th	2 39 0	N.13 35	...	14·17

Mercury rises about an hour before the sun on the 1st, the interval increasing to an hour and three-quarters in the middle of the month, the interval then decreasing.

Venus is too near the sun to be well observed.

Mars rises three hours before midnight at the beginning of the month, the interval increasing. He can be observed throughout the night.

Jupiter rises before sunset and can be seen throughout the night at the beginning of the month. At the end of the month he sets nearly three hours before sunrise.

Saturn rises about an hour after sunset at the beginning of the month, the interval decreasing.

ASTRONOMICAL OCCURRENCES FOR SEPTEMBER, 1879.

DATE.		Principal Occurrences.	Jupiter's Satellites.	Meridian Passage.
		h. m.		h. m. s.	h. m.
Mon	1	10 3 Occultation of 101 Piscium (6)			Altair.
		11 17 Reappearance of ditto			9 2·4
Tues	2	Sidereal Time at Mean Noon 10h. 45m. 3·348s.			8 58·4
Wed	3	12 Conjunction of Moon and Saturn 8° 25′ S. Sun's Meridian Passage 0m. 40·46s. before Mean Noon			8 54·5
Thur	4	10 33 Occultation of 36 Tauri (6)	1st Oc. R.	15 7	8 50·6
		11 39 Reappearance of ditto			
Fri	5	11 16 Occultation of k Tauri ($5\frac{1}{2}$)	1st Tr. I. 12 19 1st Sh. I. 12 27 2nd Tr. I. 13 36 2nd Sh. I. 13 53 1st Tr. E. 14 38 1st Sh. E. 14 46		8 46·6
		12 19 Reappearance of ditto			
Sat	6	10 45 Near approach of 132 Tauri ($5\frac{1}{2}$)	1st Oc. D.	9 34	8 42·7
		14 Conjunction of Moon and Mars 6° 55′ S.	1st Ec. R.	12 0 27	
Sun	7	15 28 Occultation of B.A.C. 2238 (6)	2nd Oc. D. 8 2 1st Tr. E. 9 4 1st Sh. E. 9 15 3rd Tri. I. 11 6 2nd Ec. R. 11 12 55 3rd Sh. I. 11 51 3rd Tr. E. 14 36 3rd Sh. E. 15 25		8 38·8
		16 29 Reappearance of ditto			
Mon	8	8 4 ☾ Moon's Last Quarter	1st Ec. R.	6 29 12	8 34·8
Tues	9				8 30·9
Wed	10				8 26·9
Thur	11	16 48 Occultation of B.A.C. 3529 (6)			8 23·0
		17 35 Reappearance of ditto			
Fri	12		1st Tr. I. 14 3 1st Sh. I. 14 22 2nd Tr. I. 15 53		8 19·1
Sat	13		4th Tr. I. 10 18 1st Oc. D. 11 18 4th Sh. I. 13 23 1st Ec. R. 13 55 38 4th Tr. E. 14 28		8 15·2
Sun	14	16 Conjunction of Moon and Mercury 5° 14′ N.	1st Tr. I. 8 29 1st Sh. I. 8 51 2nd Oc. D. 10 15 1st Tr. E. 10 47 1st Sh. E. 11 10 1st Ec. R. 13 48 10 3rd Tr. I. 14 22		8 11·2

DATE.		Principal Occurrences.	Jupiter's Satellites.		Meridian Passage.
		h. m.		h. m. s.	h. m.
Mon	15	17 56 ● New Moon Illuminated portion of disc of Venus=0·026 Illuminated portion of disc of Mars=0·886	1st Ec. R.	8 24 25	Altair. — 8 7·3
Tues	16	11 Conjunction of Moon and Venus 4° 7′ N.	2nd Tr. E. 2nd Sh. E.	7 53 8 42	8 3·4
Wed	17	Saturn's Ring : Major axis=44″·24 Minor axis= 7″·24			7 59·4
Thur	18	Sidereal Time at Mean Noon 11h. 48m. 8·20s.	3rd Ec. R.	9 14 12	7 55·5
Fri	19	Sun's Meridian Passage 6m. 10·26s. before Mean Noon			7 51·6
Sat	20	7 46 Occultation of B.A.C. 6369 (6) 8 24 Reappearance of ditto	1st Oc. D.	13 3	7 47·6
Sun	21		1st Tr. I. 1st Sh. I. 2nd Oc. D. 1st Tr. E. 1st Sh. E.	10 13 10 46 12 30 12 32 13 4	7 43·7
Mon	22	9 19 ☽ Moon's First Quarter	1st Oc. D. 1st Ec. R.	7 29 10 19 43	7 39·8
Tues	23	14 Inferior conjunction of Venus and Sun	1st Tr. E. 2nd Tr. I. 1st Sh. E. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E.	6 58 7 19 7 33 8 28 10 11 11 21	7 35·8
Wed	24	7 12 Occultation of θ Aquarii (4½) 8 27 Reappearance of ditto			7 31·9
Thur	25		3rd Oc. D. 3rd Ec. R.	7 15 13 15 30	7 27·9
Fri	26				7 24·0
Sat	27	11 Conjunction of Moon and Jupiter 5° 16′ S.	1st Oc. D.	14 48	7 20·1
Sun	28		1st Tr. I. 1st Sh. I. 1st Tr. E. 2nd Oc. D. 1st Sh. E.	11 57 12 40 14 16 14 47 14 59	7 16·2
Mon	29	21 17 ○ Full Moon	1st Oc. D. 1st Ec. R.	9 15 12 15 8	7 12·2
Tues	30	10 1 Near approach of 47 Arietis (6) 11 13 Occultation of ε Arietis (4½) 11 43 Reappearance of ditto 15 Conjunction of Moon and Saturn 8° 22′ S.	1st Sh. I. 4th Sh. I. 1st Tr. E. 1st Sh. E. 2nd Tr. I. 2nd Sh. I. 4th Sh. E. 2nd Tr. E.	7 9 7 40 8 44 9 28 9 39 11 7 12 1 12 31	7 8·3
OCT. Wed	1		1st Ec R.	6 44 3	7 4·4

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN SEPTEMBER, 1879.

By W. R. Birt, F.R.A.S., P.S.S.

In order to assist observers in determining, at least approximately, if there be any periodicity in the varying appearances of such objects as the white spot on the *Mare Crisium*, west of *Picard*, or the northern streak from *Proclus*, we shall transcribe from our observation book a few passages recording on certain dates their appearances and alignment. On April 1, 1873, between 7h. and 7h. 50m., G.M.T., with terminator grazing the eastern edges of Atlas and Guttenberg, Picard A (Peirce) and Picard B (Peirce B) were recorded as very distinct and conspicuous with shadows within, also B. and M.'s craters *d* and F, with the smaller crater (just discernible in this glass of 2·75-inch aperture, power 100, and with this atmosphere in which there is much yellowish mist) on the S.W. of it. These craters were surrounded with the *usual* darkish brown tint, especially Picard and A (Peirce); it extended some distance from and around them. The above were the only craters I was able to see. I could not obtain a trace of the white cloudy patch west of Picard. About W.S.W. of Picard, just beyond the dark tint, is a very faint surface, rather, but very slightly, brighter than the general surface of the *Mare*, this faint object aligns thus: Picard, N. edge; N. edge of Webb's ancient ring; the central part of Proclus. The eye could only be kept steadily upon it with the utmost attention.

1873, April 2, 6.45 to 7.35, G.M.T. White spot W. of Picard aligns as follows—central part: N. edge of Picard; N. edge of Proclus. It is more decided to-night, but still very faint. The line passes over the crater *l* of Schröter, which is very distinct. This crater is situated on the extremity of the ridge which partly encloses Webb's ancient ring, the area of which is quite perceptible by its tint. The part of the white spot seen last night was rather more northerly than the central part seen to-night. The west edge of the white spot is almost two diameters (shortest) of Picard from its west edge. *Rays from Proclus.* The north ray passes between A (Peirce) and B (Peirce B), the middle ray passes over the mountain north-west of the crater *l*, the south ray scarcely traceable—its probable direction is over *l*, towards the N. edge of Gartner and Daniell, and western edge of Theophilus, the ridge from Beaumont to Theophilus very distinct.

1873, April 3, 7.0 to 8.0 G.M.T. White spot W. of Picard, the northern part aligns with the northern edges of Picard and Proclus. The spot is still very faint, but brighter than last night. There is a faint spot about half the size north of it. The distance of the white spot from Picard about the same as last night. The middle and northern of the streaks from Proclus are more decided than last night, and rather more northerly in direction, the northern streak just includes the crater B (Peirce A), and the middle streak is a little, but very slightly, north of the mountain N.W. of the crater *l* of Schröter. The southern streak is directed towards Picard; it is much fainter than either of the others, about half the intensity of light. Terminator through Aristoteles (ring just complete, but *headed*) and Eudoxus, through the *Mare Serenitatis*, a little east of Bessel. The difference of altitude of the east and west borders of Bessel is very apparent, the western being the highest. The terminator passes west of Menelaus, and some little distance east of Delambre.

The above recorded phenomena, the morning terminator advancing from the eastern edges of Atlas and Guttenberg to the coming into sunlight of Eudoxus and Aristoteles, and the terminator crossing the *Mare Serenitatis*,

will indicate the appearances that are likely to be presented both by the white spots and streaks from Proclus, between these epochs, or rather between these positions of the terminator. On the above three days of observation the day elapsed of the Julian period would be respectively, 1873, April 1, 2 and 3, 2405250, 51 and 52, see table in *Nautical Almanac*, 1879, p. 494. From this table the days elapsed for any subsequent observation may readily be found, and consequently the days between the observations of 1873 and those of later dates easily determined.

For facilitating the comparison and discussion of observations, the day elapsed of the Julian period for the following days in September are appended—

September 8. 2407601 18. 2407611 28. 2407621

Water Lane, Stratford, E.:
August 4, 1879.

JUPITER.

1879. oh. Gr.	Angle of position of 24's axis.	Latitude of Earth above 24's equator.	Latitude of Sun above 24's equator.	Equat. diameter.	Greatest phase.
	°	°	°	″	′
Sept. 7	336·01	+1·43	+1·21	49·02	0·01
17	336·20	1·39	1·25	48·58	0·05
27	336·37	+1·33	+1·30	47·82	0·12

The assumed First Meridian passes the middle of the illuminated disk at the following times:

1879.	G. M. T. h. m.		h. m.		h. m.
Sept. 1	10 35·6	Sept. 12	4 34·7	Sept. 22	2 44·1
	20 30·4		14 30·1		12 39·5
2	6 25·7	13	0 25·5		22 34·9
	16 21·1		10 20·8	23	8 30·4
3	2 16·5		20 16·2		18 25·8
	12 11·8	14	6 11·6	24	4 21·2
	22 7·2		16 7·0		14 16·6
4	8 2·6	15	2 2·4	25	0 12·0
	17 58·0		11 57·8		10 7·4
5	3 53·3		21 53·2		20 2·8
	13 48·7	16	7 48·6	26	5 58·2
	23 44·1		17 44·0		15 53·6
6	9 39·4	17	3 39·3	27	1 49·1
	19 34·8		13 34·7		11 44·5
7	5 30·2		23 30·1		21 39·9
	15 25·5	18	9 25·5	28	7 35·3
8	1 20·9		19 20·9		17 30·7
	11 16·3	19	5 16·3	29	3 26·2
	21 11·7		15 11·7		13 21·6
9	7 7·0	20	1 7·1		23 17·0
	17 2·4		11 2·5	30	9 12·4
10	2 57·8		20 57·9		19 7·9
	12 53·2	21	6 53·3	Oct. 1	5 3·3
	22 48·6		16 49·7		14 58·7
11	8 43·9				
	18 39·3				A. M.

Assumed daily rate of rotation 870·60°.

VARIABLE STARS, SEPTEMBER, 1879.

Approximate times of maxima and minima, according to Schönfeld and Winnecke.

1879.	G.M.T. h.			R.A. 1855. h.	m.	s.	Decl. °	′
Sept. 2		R Comæ	max. 8	11	56	49	+ 19	35·4
—		R Arietis	min. 12	2	7	53	+ 24	22·8
3	11·3	λ Tauri	min. 4	3	52	39	+ 12	4·6
4		η Geminorum	min.					
7	10·1	λ Tauri	min.					
10		R Sagittæ	min. 10	20	7	27	+ 16	17·4
11	9·0	λ Tauri	min.					
—		T Aquarii	max. 7	20	42	17	— 5	40·9
—		Mira Ceti	max.	2	12	1	— 3	38·3
—		T Cassiopeiæ	max. 7·8	0	15	25	+ 54	59·3
12		T Geminorum	max. 8·9	7	40	36	+ 24	5·5
—		R Corvi	max.	12	12	8	— 18	26·9
—		R Virginis	min. 11	12	31	9	+ 7	47·2
13	16·5	Algol	min.					
16		S Boötis	max. 8	14	18	1	+ 54	28·3
—	13·3	Algol	min.					
17		R Cancri	max 7	8	8	34	+ 12	10·1
19	10·1	Algol	min.					
20	10·7	U Coronæ	min. 9	15	12	17	+ 32	10·8
22	6·9	Algol	min.					
—		S Vulpeculæ	min. 9·10	19	42	27	+ 26	55·7
25	3·7	Algol	min.					
—		R Leonis	max. 6	9	39	45	+ 12	5·9
26		T Ursæ Maj.	max. 7	12	29	47	+ 60	17·2
27	8·4	U Coronæ	min. 9	15	12	17	+ 32	10·8
28		S Pegasi	max. 8	23	13	13	+ 8	7·6

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

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Squire, H.	Corbett, C. J.	Lancaster, J. L. Lancaster, W. L.

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The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON, 11, *Angel Court, Throgmorton Street, E.C.*, **not later than the 20th of the Month.**

The Astronomical Register.

No. 202. OCTOBER. 1879.

HYGINUS N.—(Continued).

By E. Neison.

When the news of Dr. Klein's discovery reached England every endeavour was made to obtain observations of the supposed new crater. The day to observe it was April 9th, and this evening was anxiously expected. Near London the day was dull, but towards evening the clouds broke a little, and a high wind sprang up. It seemed not improbable that the night would be fine. I had an engagement in town for that evening, but feeling the importance of obtaining an observation of the supposed new crater, I held myself in readiness to leave London and run down to a friend's observatory, as I knew my host would excuse me under the circumstances. As the afternoon wore on, the day became worse, the wind became squally, and the clouds thickened. At six o'clock it was evident that it was hopeless to expect observations on this evening, so I gave up all idea of being able to decide for myself whether this supposed new crater did or did not exist. The next day I went down to the Royal Astronomical Society, anxious to obtain news, for the broken nature of the clouds on the previous evening had led me to hope that others might have been more fortunate than myself. I learnt, however, that all over the neighbourhood of London the weather had been equally bad, dense clouds, squalls of wind, and rain. Our only hope of obtaining observations lay in the more distant districts, and I knew I should hear from these by the next morning.

On the 11th I heard that all over England the weather had been bad, and not a single observer had obtained a view of the moon. This was very disappointing, for it seemed certain that we should have to wait until next month before obtaining the required observation. The next month I little suspected what was in store for us, when I was thinking it was only a question of waiting for the next lunation, though, knowing the great importance of the subject, even that delay seemed momentous. The evening of April 11, though cloudy, was at intervals sufficiently fine to enable Mr. A. A. Common to obtain a view of the moon, with his fine 18-inch reflector. Examining the region near Hyginus he saw a dark spot to the north-west of the crater Hyginus. At the time it was thought that this was really Klein's object, but it is now known that it was not Hyginus N, but a larger dark spot further to the west. In fact, on this evening the sun was so high in this region that N must have been invisible.

Later, a letter was received from Mr. I. W. Ward, of Belfast, the well-known double-star observer. In this letter he announced that, on the evening of April 9th, he had succeeded in obtaining a short view of the moon, between a break in the clouds. To the north-west of Hyginus he saw a black, crater-like object in the place assigned to Klein's crater, in Mr. Sadler's letter to the *English Mechanic*. This was an important confirmation of Klein's observation, and seemed to show that a dark, crater-like object did exist in this region. Still later in the month a communication was received from Dr. Klein, announcing that he had succeeded in obtaining an observation of the new crater on April 9th, it having been fine for nearly the whole evening. In fact it appears to have been only in England that the weather was so uniformly bad. Had it been possible for the officials of the Selenographical Society to have as generally warned the continental astronomers as they had the home observers, it is probable that some important observations might have been obtained on this night. Unfortunately this was not possible.

The observations of Dr. Klein and Mr. Ward may be summarised as follows:—

April 9th, 1878. Terminator + 2°. Ward. Hyginus N visible as a distinct black crater, with a soft edge, and about two-thirds the diameter of Hyginus, that is, three miles.

Terminator + 3° to + 1°. Klein. The supposed new crater appeared like a black depression, with a shallow tongue-shaped projection. It was larger

than Hyginus *b*, but smaller than Hyginus *a*. It was therefore about three miles in diameter.

These observations constituted a complete confirmation of the original observation of Dr. Klein's, and obviously placed the question of the new crater on an entirely different footing. Up to this period it had seemed not improbable that there had been some error in the original observation of May 19th, and that future observations would fail to confirm Dr. Klein's idea as to the actual size and conspicuousness of the dark, crater-like spot seen by him. This explanation was no longer valid. The editors of the *Selenographical Journal* decided, therefore, to publish a rough outline map of this region, showing the place of Klein's crater. This was accordingly done. Unfortunately on this map Hyginus N is placed too far to the west, in accordance with an imperfect tracing sent over to England by Dr. Klein. This error in the position was partially the cause of the confusion which shortly arose as to the place of the new crater. In continuing to record the observations of the supposed new crater, all doubtful observations will be omitted, as it is useless to consider observations about whose nature there is any uncertainty. Thus I leave out a number of early observations, including a series by Mr. Backhouse, but it is now known that they do not relate to Hyginus N, but to other spots. All these must be omitted.

May 9th was the next opportunity for observing this region of the moon under the proper illumination for seeing Hyginus N. Determined to do my best to ensure, as far as possible, a good chance of obtaining an observation of the region, I accepted an invitation, kindly given me by Mr. Campbell, to observe the moon with the fine 6½-inch Alvan Clark of the Arkley Observatory. Situated on the southern slope of the ridge extending from Barnet to Bushey, the observatory is well placed for lunar observation, especially when the lunar altitude is low, and the moon is lying near the south-west horizon. Mr. Sadler made arrangements to observe at Clapham, and Mr. Common to observe at Ealing.

May 9th duly came, and opened with a cloudy morning. I left London in the afternoon, and on my way down cast many an anxious glance at the sky; it did not seem promising, but it improved gradually as London was left behind, the sun came out, and I began to be sanguine of obtaining a fine evening. This was not to be. In the evening clouds gradually came over the entire sky. The moon shone feebly through them, and Mr. Campbell and myself anxiously endeavoured to peer through them at the region near Hyginus. There seemed to be an elliptical dark grey marking in the place assigned by Dr. Klein to his

crater, but it was impossible to feel sure of its identity on account of the veil of white clouds. These clouds gradually thickened, and the moon slowly vanished behind them. For a second time I was disappointed.

I was in hopes that others might have been more successful, and that the weather might have been clear enough to the south of us to enable either Mr. Common or Mr. Sadler to have secured observations. It turned out, however, that they had been far less successful, and had not been able even to see the moon. Mr. Backhouse appears to have obtained an observation of the moon, but, misled by the erroneous place assigned to N, looked for it too far west. On the 10th of May, Mr. Sadler observed a dark spot in this region, and on May 11th a dark spot was seen by Mr. Knott, at Cuckfield, and by myself at Ealing. This spot was not really the crater, but one lying farther west.

In Germany, Dr. Klein obtained a further view of the Moon on May 9th, but the definition was bad. In the place of Hyginus N he saw a dull, grey spot. On the next day the crater was visible as an indistinct greyish marking.

Baffled again by the weather there was no alternative but to await the next lunation, when, on June 7th, another opportunity would be had of observing this region. On June 7th, however, it poured with rain, and no one succeeded in obtaining a view of the moon. Not only was the weather bad in England, but it was cloudy throughout Europe. It was, however, only the beginning of a series of disappointments. July 6th, the next opportunity of observing this region under proper illumination, duly arrived, but though the morning was fine, towards the afternoon it clouded over, and no observations could be obtained. On July 20th the first good opportunity presented itself for an observation of this region under evening illumination. It was cloudy throughout, though the preceding evening had been fine. The August lunation arrived, only for clouds to effectually baffle all observation at the morning illumination. There remained the day when this region could be seen under evening illumination. This would be August 19th; August 18th was cloudy in England, but was fine in the south of France, where the moon was observed by M. Gaudibert with an 8½-inch reflector. The occasion was not favourable, for the sun was still high above the horizon, and the definition was not good, so that M. Gaudibert was compelled to employ a low power. He did not observe any trace of Hyginus N.

On August 19th, through the kindness of Mr. Campbell, I had again the opportunity of observing the moon with the 6½-inch Alvan Clark of the Arkley Observatory. My calculations had

shown me that the terminator would be very close to Hyginus by the time of moon-rise, and would be rapidly advancing, so that unless the moon were observed closely after it rose it was not unlikely that this portion of the lunar surface would be already buried in the shades of night. It was, in fact, a real race between the moon rising above the eastern horizon, and the dark shadows falling on this portion of the lunar surface. Which would win I could not be sure, for it all depended on the condition of the atmosphere. If the air were clear and steady, the moon could be observed from half-an-hour after moon-rise, if unsteady and hazy, not for fully an hour later. The race was so close that one hour was everything. It was, therefore, a great advantage to be able to avail myself of the Arkley Observatory, for it was extremely well placed for observing the moon immediately after its rising.

The morning of the 19th August was bright and sunny, and the blue sky and round cumulous clouds gave every indication of a splendid evening. As the day wore on it looked still more promising, and on leaving London I had little doubt about the weather being all that I could desire; it was just one of those magnificent afternoons which my experience had shown me gave splendid calm nights. The train had scarcely emerged from London, than right away to the north-west I saw a belt of low-lying clouds—suspicious clouds, very different from the rounded, cumulous masses that had been floating overhead in the early part of the afternoon. As we rapidly sped on towards the Hertfordshire hills the cloud belt grew thicker and more ominous, until, on leaving the train at my journey's end, the whole sky was overcast with a dense mass of grey rain clouds. It was a pleasant prospect, not a ghost of a sign of blue sky anywhere. There was a mile-and-a-half to drive, and long before the dog-cart had performed half this distance the heavy rain-drops commenced to fall. My sanguine anticipations of observing the moon were turned into every probability of obtaining a drenching. Fortunately the rain held off until I reached my destination, and then it poured with tropical violence, with every appearance of lasting for hours.

On sitting down to dinner I could hear the rain falling heavily on the terrace outside, gradually the sound faded away as the rain lost its tropical character, and settled into a steady, hopeless downpour. All hope had been given up of obtaining any glimpse of the moon for that night. My delight may be imagined when, shortly after ten o'clock, a message came in to say that it was a fine, starlight night. We went out, it was a magnificent night, the stars shining out with that steady lustre so common after a heavy rainfall, and not a cloud was to be seen. It

was a glorious surprise, and as we returned to the house my hopes again ran high, of a night's observation which would decide the momentous question whether Klein's crater was or was not a new formation.

Shortly before eleven Mr. Campbell and myself sallied out to the observatory, distant about two hundred yards from the house. Right down the valley, over the trees of Trent Park, some three miles distant, was a glare of light; it was the prelude to moonrise. As we watched, the glare increased, and slowly the moon rose over the trees with scarcely a ripple, showing the wonderful steadiness of the air. My choice had been fortunate, steady air and a clear sky, it was all that could have been hoped for. We went into the observatory and opened the shutter, and then for the first time I noticed some thin bands of filmy clouds lying low down on the eastern horizon, just over the moon. As the moon rose these clouds seemed to broaden and thicken, it was the light of the moon revealing this hitherto unsuspected danger.

When the telescope was turned on the moon, it was seen to have entered this cloud, which was thick enough to spoil the definition by cutting out the light so much wanted in observing a region so close to the terminator. I could dimly see the great rill of Hyginus and the broad masses of shadow thrown by the lofty western ridges of the spiral mountain, the "Schneckenberg" of Beer and Mädler. More could not be seen on account of the thin clouds. Nothing could be done until the moon had risen above the thin belt of clouds which was marring everything in so unexpected a manner.

Looking at intervals I saw the terminator gradually approaching Hyginus, and what was still more ominous, the shadows cast by the peaks of the spiral mountain were rapidly increasing in length. It was a race which would first ensue, would the moon succeed in rising clear above the seemingly narrow belt of clouds, or would the shadows gain the mastery, and immerse the lunar plain in darkness. Minutes went by, minutes precious, for they could not be retraced. At last the moon neared the edge of clouds, its upper limb rose clear; intently watching, I saw through the telescope the moon slowly sail clear of the well defined upper edge of the cloud belt; the crater! where was it? Too late! Too late! The broad shadow of the high western arm of the Schneckenberg lay right over the plain, casting everything into shadow. The clouds had won, and our labour was lost.

By intent gazing I could distinguish just on the border of the shadow, within the penumbra in fact, a dark elliptical spot. It may have been a crater or dark spot, but it was too late to properly ascertain its form and nature, The night was fine, and

the air comparatively steady, so I made a sketch of the locality, but that trifling belt of hazy clouds had effectually ruined our main purpose, and postponed until another year my observation of this region.

In England no other observer seems to have succeeded in obtaining a view of the moon on this evening. In France M. Gaudibert was more favoured, and obtained a view of the moon, but not until several hours after the epoch of our observations, and when Hyginus N. must have long been immersed in the shades of night.

With the August number of the Selenographical Society was issued an outline map of the region around Hyginus, and in this map the position of N was much more accurately placed, though a little too far north. Since its appearance the observations of N have been far more accordant than before.

On September the 3rd the weather was again bad, but this was of less importance as it was not a favourable occasion for studying this region. September 17th was a far better opportunity, but the weather was cloudy in England, and my attempts to observe this region were again foiled.

In France M. Gaudibert succeeded in obtaining an observation on September 17th. It may be given as follows:—

September 17th. Terminator + 10°. Gaudibert. Air unsteady, power low. Near the place of N was a white hillock or low mound. No dark crater-like spot was visible.

It would appear, however, from the drawing that it is not improbable that there is an error in the date of this drawing, and it should be dated September 16th.

The next day for observing this region was October 3rd, but clouds again prevented any observation being obtained in England. In Germany, Herr Bónffay, of Funfkirchen, was more fortunate, and obtained a view of this region with a 4-inch refractor, and power 200, on the evenings of October 3rd and 4th.

October 3rd. Terminator + 3 to + 1°. Bónffay. Hyginus N distinctly visible as a distinct crater nearly as large as Hyginus, only not quite so deep; it was quite as distinct as Hyginus. South of it was a smaller crater.

October 4th. Terminator — 10° to — 12°. Bónffay. Air unsteady. No trace of Hyginus N could be seen.

It will be seen that these observations by Herr Bónffay completely confirm the description of Dr. Klein.

On October 16th this region was observed by Lord Lindsay at

Dun Echt, and by M. Gaudibert in the south of France, but clouds prevented observations being made in England. The region was seen under evening illumination, the solar altitude being from about 14° to 11°. Lord Lindsay did not observe the crater, but it is not unlikely that he looked for it too near to Hyginus. M. Gaudibert drew the region, and close to the place of Hyginus N he shows a small crater-like hill united by a narrow arm with the spiral mountain. It is not impossible that this white spot was the crater-like hill to the north of N. Under this illumination the supposed new crater N ought to have been visible as an ill-defined greyish spot. But although M. Gaudibert did not show N, it is by no means certain that he did not see it, for there are a number of rounded dark surface markings in this region, none of which are shown by M. Gaudibert, though doubtlessly seen by him, and it is quite possible that N was supposed to be one of these, and so omitted from the drawing which does not profess to show these markings.

On October 17th this region was again examined by Lord Lindsay and Dr. Copeland at Dun Echt, and by Mr. Pratt at Brighton, though clouds prevented other observers from seeing the moon.

October 17th. Terminator + 9°. Pratt. A drawing was made showing the region north of Hyginus. The shadow of the western arm of the spiral mountain is shown as extending right up to the place of N, and a little south-west of the end of the shadow is drawn a hill, casting a long shadow. Mr. Pratt remarks that nothing was visible of the character of Klein's new crater.

October 17th. Terminator + 8° to + 6°. Lindsay and Copeland. Six drawings, of which only the first shows the region containing N, on all the others it is lying outside the area sketched. In this first drawing the shadows are filled in very imperfectly. The shadow of the western arm of the spiral mountain is shown as extending right up to the foot of the ridge forming the north-western border of the plain, and, therefore, extending right over the place of N. It must, therefore, have been invisible at this time, which accounts for Lord Lindsay not seeing it. At the epoch of this drawing a mountain 1,000 feet in height, like the western arm of the *Schneckenberg* would cast a shadow over ten miles in length.

Lord Lindsay's failure to see N is therefore accounted for; it

remains to consider the reason why Mr. Pratt did not succeed in recognising Klein's crater. Hyginus N lies about five miles distant from the crest of the western arm of the *Schneckenberg*, which is a mountain arm not quite 1,000 feet above the plain at its western foot. At the time of Mr. Pratt's drawing, this mountain arm must have cast a shadow about three-and-a-half or four miles long, so that this shadow should just have reached the nearest edge of N, which would have its eastern portion overshadowed by the penumbra of the shadow of the *Schneckenberg*. Now, turning to Mr. Pratt's drawing, what do we find? A shadow between six and seven miles long, with its extremity just of the shape and in the very position of Klein's crater, which would then be a black pit filled with shadow and perfectly indistinguishable from the shadow of the mountain arm. If Mr. Pratt's delineation of these shadows is trustworthy, the whole of the shadow shown could not have been due to the spiral mountain, for it would make its height fully 2,000 feet, which is far too great. It seems, to me, most probable, therefore, that what Mr. Pratt took for the extremity of the shadow of the western branch of the *Schneckenberg* was really Klein's crater filled with black shadow. On the other hand, if what Mr. Pratt draws was really the shadow of the mountain, then Klein's crater must have lay beneath it, for it covers its place.

The next opportunity for observing this region was November 2nd, though it was an unfavourable one, for the sun was fully 10° above the horizon of the crater, so that it would only be visible as a dark spot. Thin hazy clouds again baffled all attempt near London to see this region. It was seen, however, by Mr. Rand Capron, of Guildford, Mr. J. Baxendell, of Birkdale, and by Captain Noble, of Maresfield. Captain Noble's sketch does not show the region containing Klein's crater, so it can be dismissed at once.

November 2nd. Terminator — 3°. Rand Capron. Hyginus N seen "as a moderate sized, very slightly oval, cup-like cavity, of greyish-black tone, with an indistinct lighter margin or rim. The cup was more deeply shaded on the side towards the sun, whilst the rim or margin was lighted up on the other side. No focussing would give detail; and this nebulous object was in great contrast with the surrounding objects."

November 2nd. Terminator — 3° Baxendell. Hyginus N appeared as a round and very dark spot, and was slightly less black than the shadow in Triesnecker. Its diameter was estimated as two-thirds that of Hyginus *a*. In

moments of good definition a narrow line of light was seen on its eastern border. Klein's tongue-shaped depression towards the south was also seen. Half an hour later the spot did not look near so dark.

It will be seen that Mr. Rand Capron's observation completely confirms those of Dr. Klein, and practically so does that of Mr. Baxendell, though this shows some slight discordances.

November 3rd. Terminator — 12°. Baxendell. The new crater still appeared like a dark spot, but not nearly so dark as on the previous evening.

November 4. Terminator — 25°. Baxendell. The new crater appeared like an irregular ill-defined spot, slightly brighter than the surrounding district.

To me it appears very doubtful whether this last observation really refers to Klein's crater at all; my own observations seem to me to be convincing that Klein's crater disappears completely under high illumination and that it is really the white spot *t* on the south border which was taken by Mr. Baxendell for N. This white spot fully answers to the description.

The two next occasions on which this region could be observed under proper illumination were December 1st and December 15th, both days proved cloudy, however, and nothing could be seen of the moon. I will here insert, however, three other observations which I shall have to refer to.

December 4th. Terminator — 32°. Rand Capron. Air unsteady. "In the place of Klein's crater was a dull spot, darker than the surrounding region, fairly well defined, but apparently flatter and less cup shaped, and more even in bend than in 1878, November 2. Its margin was sharper and better defined than on that date, and the side most lighted up was distinctly ragged and broken up. The most curious feature was that the whole object was apparently considerably larger than on November 2, extending closer to Hyginus on the one side and to the bright range on the other."

December 4. Terminator — 34°. Baxendell. Klein's crater presented the same appearance as on November 4th.

Now, from the preceding observation of Mr. Rand Capron, it appears certain that Klein's crater was not really visible on this day. For there is now no doubt that the object seen by Mr. Rand Capron was not N, but the dark surface marking lying

on the west edge of N. Not only does Mr. Rand Capron's sketch and description render this certain, but his later observations completely confirm it. It could not, therefore, have been N which was seen by Mr. Baxendell, but it must have been the white spot already referred to, which lies on the north of N, and on the south-east of Mr. Capron's spot. It is now rendered certain from the observations of Schmidt, Klein, and others, besides my own, that N is completely invisible under a high sun, conforming in this respect with all the other analogous formations on the moon, and on the south-west quadrant any number of similar formations can be found.

December 5. Terminator — 49°. Baxendell. Klein's new crater is now a moderately bright spot.

This observation is in agreement with the conclusions already arrived at, that Mr. Baxendell was not observing N, but the hill *t* to the south of it.

This concludes the observations made in the year 1878, there remain to be considered the observation of the early part of this year, during which period great light was thrown on the true nature of this object. The preceding observation will show the remarkable fatality which attended all the attempts by the more experienced lunar observers to observe this part of the moon. Having devoted especial attention to this part of the moon for five or six years, and having most carefully studied its details and all the changes in appearance it undergoes with the changing illumination, I do not think I exaggerate in saying that it was most important that I should be able to make observations of this supposed new crater, yet the bad weather most effectually prevented this for the whole year, and so threw the entire question into confusion.

(*To be continued.*)

OBSERVATION OF THE OCCULTATION OF ANTARES, July 28, 1879.

By M. C. Flammarion.

(Translated for the Astronomical Register.)

The state of the sky was more favourable for the observation of this phenomenon than one would have expected, considering the persistency of bad weather which has prevailed for nearly a

year. The atmosphere was of a rare transparency and remarkable calm. I observed the occultation with especial view of the duplicity of the star. Antares (mag. 1, 7) presents an orange colour more intense than α Herculis, and its companion, of the 7th mag. a tint of emerald green approaching blue. The companion precedes, and when the pair reached the dark limb of the moon, the small star first instantaneously disappeared, then the other equally instantaneously. The moon was in its tenth day; its dark limb was quite invisible, and the immersion always surprises one, although one's whole attention is expressly fixed on it. The dark limb where the immersion took place was not far distant from the meridian illumined by the rising sun, and the silvered peaks of the lunar mountains well set off the vividness of the flaming brightness of Antares. It was a contrast between silver and the flame of a wax-light. The triple boundary wall of Copernicus was admirably defined. The circle of Mayer was first on the terminator, and the effect of the oblique illumination caused that circle to appear plainly set on the very crest of a chain of mountains extending from one part and the other, and overhanging to the east an immense plain still, at 8h. 30m., in the darkness of night, whose very uneven surface had its principal heights illumined at the moment of immersion, 9h. 48m. The emersion, (10h. 26m.) took place at the illumined limb at the sea of Humboldt. The green companion came out first, immediately followed by Antares; a fugitive moment, yet sufficient to show that the colour of the small star is not an effect of contrast due to the orange star, but in fact a real and certain colour. Neither when the lunar limb covered or quitted the double star was there manifested any sign of absorption or atmospheric refraction. It was precisely on the occasion of a similar occultation that the companion of Antares was discovered by Burg in 1819. Then, as now, it preceded the large star. Its relative movement is insensible after 60 years. Here are all the observations that I have been able to bring together:—

	Angles.	Distances.	Observers.
	°	″	
1819 ...	270 ±	n. m.	B.
1846 ...	270 ±	2·52	Mt.
1848 ...	273,2	3·46	Da.
1848 ...	273,0	3·11	Mt.
1848 ...	273,3	3·60	Bo.
1849 ...	276,2	3·69	Mc.
1855 ...	274,6	n. m.	Po.
1856 ...	273,5	3·2	Ja.

		Angles.	Distances.	Observers.
		°	"	
1856	...	273,5	3·0	Se.
1857	...	275,1	3·4	Ja.
1857	...	270,0	3·5	Sm.
1858	...	275,8	3·30	Wr.
1861	...	271,9	n. m.	Po.
1864	...	275,7	3·67	Da.
1864	...	275,8	3·37	Da.
1865	...	270,4	2·99	De.
1866	...	272,9	2·92	Se.
1873	...	268,7	3·46	Ws.
1874	...	268,4	3·29	Gl.
1875	...	274,0	3·22	Sp.
1876	...	271,5	3·25	Ha.
1877	...	273,6	2·86	St.

The divergency of the results arises from the difficulty of measurement. The clean separation is very difficult by reason of the rays of Antares, and the pair is more an atmospherical than an optical test. The value of the observations depends chiefly on the state of the atmosphere; last Monday the conditions were exceptional. Although the two components remain fixed, this system is a *physical* one, since the proper motion of Antares, R.A. —0,006s. and P.D. +0″,034, notwithstanding its slowness, beginning from the sure observations of 1848, would have brought the position at present to 290° and 3″·55, but the components remain fixed at 272° ±2° and 3″,2 ±0″,3. The trials which I have made with several refractors and reflectors on the separation of this star, give a result in favour of the refractors.

The neighbouring star σ, of the 4th mag., is also double, though not indicated as such either in the catalogues in general, or in the *Connaissance des Temps*. Its companion, of the 9th mag., precedes exactly, like that of Antares, but at a greater distance. It is better seen by averting the eye than fixing it. The two stars are bluish. Here are all the measurements of this couple:

		Angles.	Distances.	Observers.
		°	"	
1783	...	270,5	21,67	H.
1822	...	271,2	20,60	So.
1831	...	271,4	20,3	Sm
1834	...	274,3	15,0	H_2.
1838	...	271,6	20,5	Sm.
1846	...	272,2	20,56	Ja.

		Angles.	Distances.	Observers.
		°	″	
1847	...	271,1	22,34	Ja.
1855	...	96,0	20,37	Se.
1879	...	272,0	18,0	Cr.

For the last measurement I am indebted to M. Cruls, astronomer of the observatory of Rio Janeiro, who on the faith of the measurement of P. Secchi, thought that this pair should be added to my catalogue of double stars in motion. The comparison of all the observations shows that the pair has remained fixed, after nearly a century, at $271° \pm 1°$, and $20'' + 2''$. The angle of Secchi is difficult to explain; an error of 180° would give 276°. The proper motion of σ, R.A. —0.0038. and P.D. —0″.01, is not sufficiently well determined to enable us to conclude anything on the nature of the system.

Aug. 4, 1879.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

To all communications must be annexed the name and address of the sender, as a guarantee of good faith.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE RED CLOUD ON JUPITER.

Our attention having been called to this beautiful cloud by Mr. Birmingham's notice in *Nature*, August 21st, the 9½-inch equatorial of this observatory was turned upon it on the 31st of last month, at about 11.30 p.m. The features seen on the disk of Jupiter may be thus described:—

1. The most striking feature was, of course, the fine ruddy equatorial zone. This ruddy zone was composed of two broad bands with space between partly coloured and partly white, or bright yellow. Owing to bad definition the exact nature of the markings between the two bounding bands could not be well seen. The well-known looped, or festoon-like forms were, however, at once recognised. The lower (N.) equatorial band was the broadest and darkest on the disk.

2. The next feature which caught the eye was the beautiful

elliptical cloud already mentioned. This lay a little to the south of the upper (S.) equatorial band. It was of the same colour as the great central zone, but perhaps not quite so deep.

3. The other bands were not conspicuous, and, as Mr. Birmingham remarks, there are none of a well-defined character near the S. pole. Between the lower (N.) equatorial band and the N. pole two narrow bands were easily seen.

A few rough measures were made as follows:

The red cloud—length, 14″; greatest breadth, 3″; distance of lower edge from the southern equatorial band about 2″. Width of coloured zone about 8″.

Small detached spots were also seen just in advance of the red cloud and a little to the south.

JOSEPH GLEDHILL.

Mr. Edward Crossley's Observatory,
Bermerside, Halifax: Sept. 3, 1879.

MARS.

Dear Sir,—I desire to interest the readers of the *Register* in the coming opposition of this planet, and to point out a way by which observations may be utilized. A new map of Mars is to be found in Vol. XLIV. of the *Memoirs* of the Royal Astronomical Society, just published: if those who are interested in Mars would take this map and carefully and critically compare its details with those of the planet, the existence of permanent markings would receive valuable confirmation, and attention would be keenly directed to those parts which are less definite in their forms.

The parts of the surface where exact observation would be most valuable are:

The coast line of the De La Rue Ocean, between Burton Bay and Christie Bay. This line lies nearly on the equator, extending from long. 0° to 60°, and is variously represented in many drawings.

A careful search should be made for Lake Schiaparelli, lat. 16° S., long. 67°. It may possibly be again seen as a small spot separate from the De La Rue Ocean. If so, its time of passing the meridian of Mars should be noted, as this occurred at 14·20 G.M.T., on Sept. 1, 1877. The form of coast line between Gruithuizen Bay, and the Kaiser Sea, lat. 10° S., long 260° to 280°, requires close attention, as the drawings of the writer made during the opposition, 1873, seem to indicate a bay at about long. 270°, which did not appear in the series made at Madeira.

The shape of the Main Sea on the equator, long. 270°, requires confirmation.

Is there a lake separated from the Kaiser Sea extending N.W. from Banks' Cape, just south of the equator, and between 300° and 310° longitude? Hirt Island, lat. 20° S., long. 295°, may again be visible. Confirmation valuable, as it was only seen by a few during the last opposition.

It would be advisable to scrutinize the whole of the markings near the equator, and special search should be made for the dark canals of Professor Schiaparelli, which are represented by him as ramifying through the great equatorial continents.

Any observations sent to my address would be most welcome, and should any workers be without a copy of the map, or desire an extra copy for use in the observatory, it will be a pleasure to forward it.

NATHL. E. GREEN.

39, Circus Road, St. John's Wood, London.

SOLAR HALOS AND MOCK SUNS.

At 9.15 a.m. on the 13th September, the phenomena described below were seen at this place. They were first observed at 8.45 a.m.; were at their brightest about 9.15, and could still be partly seen at 10 o'clock. The upper stratum of cloud was a thin sheet of dull white cloud; detached dark clouds passed slowly below in the S.W. current.

The sun was in the S.E., and his altitude was about 40°. The principal halo was the ordinary one, which may often be seen several times a week. At the point where the vertical passing through the sun intersected the upper part of this halo a bright arc was seen having its centre somewhere above the point of contact. From the same point there were two brightly-coloured arcs curving downwards to the right and to the left outside the principal halo and extending downwards until they intersected the horizontal diameter of that halo produced to right and left about 15°. Above this system and near the zenith were two other brightly-coloured arcs, each about 20° in length, and having their centres on opposite sides of their point of contact. All the above were coloured, the red being inside. The light was brightest and the colours most vivid in the upper part of the principal halo where the three arcs intersected it.

Again: at the extremities of the horizontal diameter of the principal (and only complete *coloured* halo) were mock suns.

But, perhaps, the most beautiful sight was the grand white

circle parallel to the horizon and passing through the sun, and the two mock suns just mentioned. This circle was distinctly seen from the western mock sun all round by the N. and E. up to the mock sun on the eastern side of the principal halo. On it were two other mock suns, one in the S.W.W. and the other in the N. This circle could not be seen *within* the primary halo.

At one p.m. a portion of the principal halo could still be seen, but an hour later the whole sky became overcast with cloud, and at 3.30 p.m. rain began to fall.

JOSEPH GLEDHILL, F.R.A.S.

Mr. E. Crossley's Observatory,
Bermerside, Halifax.

LIST OF SUN SPOTS IN THE OLDEN TIME.

The clear state of the sun's disk that has prevailed for some time, may have turned the attention of many to the subject of sun spots as much as the abundance of these phenomena that prevailed about the maximum epoch of 1870. As to the recovery of the sun's activity being delayed, it will be seen that if we rely on Wolf's tabular list of maxima and minima, a period of as much as sixteen years has sometimes elapsed between such maxima. It would be interesting if Wolf's periods could be carried back, even roughly, previous to the invention of the telescope. No difficulty is experienced in noticing a solar spot of 1′ in diameter, or even somewhat less, with the naked eye, when the sun is dimmed by fog, or by the mist of the horizon. But such instances of sun spots being recorded and handed down to posterity are unfortunately very rare indeed. From classical writers we get no help on the subject. Mediæval chronicles, such as the Saxon Chronicle and Chronicon Scotorum, which notice many eclipses, give no information about solar spots. If we attempt to tabulate the few recorded instances of sun spots in ancient days, we are compelled to look (1) to the Chinese records; (2) to the occasions of the sun being darkened for a time; (3) to the voyages of the early navigators. As to the Chinese accounts, the late Mr. Williams' paper, which will be found in Vol. XXXIII. *Monthly Notices*, gives 45 for a period of nine centuries. He states that he had found in the "history of the Ming dynasty, many observations of the solar spots, the latest being dated Nov. 29, 1638." Query, Is any translation of these to be found? In the paper of Mr. Hosie, on this subject, which will be found in *Nature*, June 5, 1879, several Chinese sun-spot observations are given, some of

which are not included in Mr. Williams' paper, and a few mentioned by the latter are omitted.

But the ideas about the purity of the sun prevailing among the ancients would cause very little attention in scrutinizing his face, even if our forefathers had been inclined for such observation. As to the 17 instances of the sun being obscured that are mentioned by Humboldt, the majority clearly refer to some peculiar meteorological state of the atmosphere, and a few are so coincident with the time and place where a large eclipse is known to have happened, that there can be but little doubt what sort of phenomenon is really referred to, the long duration of darkness being merely an exaggerated account heard of by the chronicler.

Tabular list of sun spots before the invention of the telescope:

4th century. Omitting the cases of "black shadows," mentioned by Mr. Hosie (may they refer to the gloom produced by a large solar eclipse?) it seems we have no distinct mention of a solar spot until a date corresponding to 301, Oct. 20. Twenty-two other instances of sun spots seen in China, occur in this century, in the papers referred to. The dates are, in the years 301, 302, 307, 321, 322, 342, 344, 345, 354, 355, 359, 360, 361, 369, 370, 372, 373, 374, 388, 389, 395, 396, 400.

5th century, Only in 499, when the sun's disk must have been in a very active state. Three fine groups noticed, in the words of the Chinese, "size of peaches."

6th century. The Chinese accounts supply us with four cases in this century: A.D. 501, 502, when two spots are noted, 577, 580.

7th century. None recorded. Perhaps the study of astronomy may have declined and revived at times in China, from internal troubles or the like cause.

8th century. No Chinese observation, but there appears to be a European one in A.D. 778 taken for a transit of Mercury. This must be the first recorded instance of a sun spot seen out of China. Tycho Brahe alludes to it in the Historia Celestis, and states that Lycosthenes mentions instances of the like being seen in the years 808 and 1278. We may as well quote the words of the original, "A.D. 778, Mercurii stella visa est in medio sole, velut macula nigra. Polyd. Vergilius lib. 3 de Prodig. Lycosthenes in prodigiis dicit id factum esse 6 calend. Apr. Idem Lycosthenes dicit quod idem accideret anno 808 et 1278."

9th century. Five sun spots in Chinese annals, in 807, 826, 832, 837, 841, 874. But we have three instances apparently out of China, what must have been a fine group being seen in 807, taken by some for a transit of Mercury, like the spot in 778. A.D. 808 is the date of another of the spots mentioned by

Lycosthenes. In 840 the phenomenon seems to have been several times witnessed during the summer months.

10th century. A.D. 974 (from the Chinese).

11th century. In 1087, 1078, 1079. In 1078 and twice in 1079 a spot seems to have been noticed for several days. There seems also a European observation in 1096. Humboldt referring to it says, "1096. On the 3rd of May, solar spots were seen with the naked eye: signum in sole apparuit v. non-Marcii feria secunda incipientis quadragesimæ."

12th century. In this century we have the spot of the Spanish Moor, Averroës, in 1161. Chinese notices are comparatively numerous. They occur in the years—

1104	1129 twice	1145
1105	1131	1160
1112	1136	1185
1118	1137	1186
1120	1138 twice	1193
1123	1139	1200

So that from 1118 to 1139 inclusive, it will be seen there was only a period of six years when there was not a spot of sufficient size to attract naked eye attention. The minimum time must have lasted a very short while.

13th century. Chinese observations in 1201, 1202, 1204, 1205, 1238, 1276; one European one in 1278, being that referred to as mentioned by Lycosthenes.

14th century. In 1370 several seen. Chinese records appear not to be translated after this.

15th century. Although nearer our own days, I have as yet come across no record of a solar spot in this century.

16th century. The spot of December, 1590, recorded by Hakluyt.

17th century. Just before the introduction of the telescope there is another instance recorded in the Hakluyt vols., which I have not seen quoted in any astronomical work. In voyage of Henry Hudson, by S. M. Asher, we have the following: "Hudson says, 'Then we observed the sunne having a slake and found our heigth to bee 70 deg. 30 min.'" A note says, "A spot." The word slake as a substantive seems to be a north-country word, meaning, according to Brocket, an accumulation of mud or slime, from slijck, cœnum, lutum. The date of this spot seems to be March 21, 1609.

Abbenhall Rectory, Gloucester: Sept. 18. SAMUEL J. JOHNSON.

THE PULKOWA TELESCOPE.

We hear from the *New York Times*, Alvan Clark and Sons, of Cambridgeport, have received from the Russian Government the order for the object-glass of the new telescope for the Pulkowa Observatory. The contract provides for a lens with a diameter 30-in., to be finished in 18 months after the glass disks are received; but two years are allowed for procuring these, so that it may be 3½ years before the glass is completed. The price is to be 32,000 dollars. The metal-work and mounting, which is to be done in Europe, will probably cost about as much more. The new instrument is to be considerably more powerful than any now existing, the Washington telescope and its sister, the M'Cormick glass, being each 26¼-in. in diameter. The Vienna telescope, now in process of construction by Grubb, of Dublin, but, if reports are correct, likely to be delayed in its completion by difficulties of construction greater than the contractors had expected, is to be of 28-in. aperture. The Newhall telescope in England, of 25-in. aperture, is the only other instrument at all comparable with these. The Russian astronomer would have been glad to obtain a considerably larger one than that finally contracted for, but the opticians would not venture on more than 30-in. The limiting difficulty lies at present in the manufacture of the raw material. It is almost impossible to procure glass disks of such size sufficiently homogeneous and free from striæ to serve for telescopic use.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN OCTOBER, 1879.

By W. R. Birt, F.R.A.S., P.S.S.

Mr. Dennett has published in the *English Mechanic*, No. 754, p. 648, col. 3, a diagram or plan of the lucid streaks in the neighbourhood of Proclus, which we particularly recommend our readers to compare with the moon itself, especially the *two* marked VIII., which are represented as *crossing* each other, and which it appears Mr. Dennett regards as manifesting a phenomenon which he call *duplicity*, but in which we see nothing beyond an intersection of *two* unconnected streaks, one of which has occupied our attention for some months past. Mr. Dennett says in a letter recently published in the *English Mechanic* in reference to this streak system, "There is a pretty budget of problems, each of which ought to be definitely answered before the study of this streak system is given up." [As if the study of any single point on the moon's surface should ever be given up.] . . . . "Now it is started, let there be a repetition of Plato's floor work having Proclus' exterior instead of Plato's

interior. Let us go to!" [A repetition of Plato's floor work is quite as important within its interior as on the exterior of Proclus.]

Mr. T. P. Gray has favoured us with some further observations as follows:—

July 28, 9.30, moon's age 9·5 days, D. J. P. 2407559. "The ground workings (dark) round Peirce and Proclus were as seen on June 28, except that the light rim surrounding the dark aureole of Peirce A, not then seen, was visible, and it protruded so as to cut off the extremity of the curved end of the streak. I could trace the light rim only on the south and west side, the streak did not pass over the aureole, but seemed rather to be diverted out of its course by it, *i.e.*, the aureole . . . I fancied I could, though with difficulty, see Peirce A just north of the curved streak." This is an important observation. The observation of Peirce A by the streak indicates that the streak is *above* the moon's surface. The observation above recorded indicates that the streak appears to have been diverted from its course by the aureole around Peirce A. We are entering on a course of observation which if persevered in will make us acquainted at least with those lunar features that require close and careful watching.

August 4, 13.30, moon's age 16·6, D. J. P. 2407566. "A thin streak of light extended from the eastern border of the Mare Crisium, which was in deep shadow to the southern edge of Peirce A where it stopped: not the slightest bend in it was observable. It did not pass over Peirce A. If it were produced in an easterly direction it would touch the south edge of Proclus."

August 28, 9.45, moon's age 11·1, D. J. P. 2407590. Mr. Gray recorded "Gave particular attention to the curve in the streak with a view of finding two crossed streaks, but could discover nothing of the sort; the dark *Mare* seemed completely to cut off the curve from any other communication with Proclus." On the same day 10.5h. to 11h. Mr. Dennett recorded "Peirce A easily visible; August 29, 11·4h., very easy and distinct; August 30, 11·3h., Peirce A very distinct."

Day of Julian Period, October 8. 2407631 18. 2407641 28. 2407651.

Errata in last list, page 220, line 8, for (*Peirce B*) read (*Peirce A*). Second paragraph, line 10, for (*Peirce B*) read (*Peirce A*); line 12, insert between *N edge* and *of Gartner* "Picard *Terminator*. Through the western part of Posidonius grazing the eastern edges."

Errata in "Personal Reminiscences of a labourer in Selenography," September 1879, page 213. Line 21 for *as well as* read *but was near a crater*; page 214, line 7 for *on foot* read *set on foot*; page 215 for their *positions* read *their legitimate positions*.

Water Lane, Stratford, E.:
September 12, 1879.

THE INNER SATELLITES OF SATURN.

Major and minor semi-axes of the apparent orbits of the satellites, expressed in semi-diameters of Saturn's equator.

		Mimas.	Encel.	Tethys.	Dione.	Rhea.
Major		3·14	4·03	4·99	6·40	8·93
Minor	Oct. 2	0·49	0·62	0·77	0·99	1·38
	„ 12	·47	·60	·74	·95	1·33
	„ 22	·45	·58	·71	·92	1·28
	Nov. 1	0·43	0·56	0·67	·88	1·23

Approximate Greenwich times of some of the conjunctions of the satellites with the centre of the ball and the ends of the ring, v. p. 216:

1879.	Gr. M. Time. h.		
Oct. 1	12·2	Tethys	nf.
	19·3	Tethys	np.
2	10·8	Tethys	sp.
	13·0	Encel	sp.
	17·9	Tethys	sf.
3	6·4	Dione	sup. s.
	8·7	Mimas	np.
	9·5	Tethys	nf.
	12·0	Encel	np.
	13·8	Mimas	sp.
	16·6	Tethys	np.
4	8·1	Tethys	sp.
	12·4	Mimas	sp.
	14·3	Encel	nf.
	15·2	Tethys	sf.
	15·2	Dione	inf. n.
5	16·7	Rhea	sup. s.
	6·8	Tethys	nf.
	6·8	Encel	sp.
	11·1	Mimas	sp.
	13·3	Encel	sf.
	13·9	Tethys	np.
6	9·7	Mimas	sp.
	12·5	Tethys	sf.
	15·7	Encel	sp.
	15·8	Mimas	sf.
7	8·1	Encel	nf.
	8·3	Mimas	sp.
	8·9	Dione	inf. n.
	11·2	Tethys	np.
	12·9	Rhea	inf. n.
	14·4	Mimas	sf.
	14·7	Encel	np.
8	7·1	Encel	sf.
	9·8	Tethys	sf.
	13·0	Mimas	sf.
9	8·5	Tethys	np.
	9·4	Encel	sp.
	11·7	Mimas	sf.
	16·0	Encel	sf.
10	7·1	Tethys	sf.
	8·4	Encel	np.
	10·3	Mimas	sf.
	15·4	Mimas	nf.
11	10·7	Encel	nf.
	11·4	Dione	sup. s.
	14·1	Mimas	nf.
12	9·7	Encel	sf.
	12·7	Mimas	nf.
13	11·3	Mimas	nf.
	12·0	Encel	sp.

1879.	Gr. M. Time. h.		
14	7·3	Rhea	sup. s.
	9·9	Mimas	nf.
	11·0	Encel	np.
	16·0	Mimas	np.
15	8·5	Mimas	nf.
	13·4	Encel	nf.
	13·8	Dione	inf. n.
	14·6	Mimas	np.
	15·9	Tethys	sp.
16	12·4	Encel	sf.
	13·3	Mimas	np.
	13·6	Rhea	inf. n.
	14·5	Tethys	nf.
17	11·9	Mimas	np.
	13·2	Tethys	sp.
	14·7	Encel	sp.
18	7·1	Encel	nf.
	7·5	Dione	inf. n.
	10·5	Mimas	np.
	11·8	Tethys	nf.
	13·7	Encel	np.
19	9·1	Mimas	np.
	10·4	Tethys	sp.
	14·3	Mimas	sp.
	16·0	Encel	nf.
	16·3	Dione	sup. s.
20	8·4	Encel	sp.
	9·1	Tethys	nf.
	12·9	Mimas	sp.
	15·0	Encel	sf.
21	7·4	Encel	np.
	7·7	Tethys	sp.
	11·5	Mimas	sp.
	14·9	Tethys	sf.
22	6·0	Dione	sp.
	6·4	Tethys	nf.
	9·8	Encel	nf.
	10·0	Dione	sup. s.
	10·1	Mimas	sp.
	13·5	Tethys	np.
	13·9	Dione	sf.
23	8·0	Rhea	sup. s.
	8·7	Mimas	sp.
	8·7	Encel	sf.
	12·2	Tethys	sf.
	14·9	Dione	nf.
	14·9	Mimas	sp.
24	10·8	Tethys	np.
	11·1	Encel	sp.
	13·5	Mimas	sf.
25	7·6	Dione	sf.

1879.	Gr. M. Time. h.		
25	9·4	Tethys	sf.
	10·1	Encel	np.
	12·1	Mimas	sf.
	14·2	Rhea	inf. n.
26	8·1	Tethys	np.
	8·5	Dione	nf.
27	6·7	Tethys	sf.
29	10·1	Dione	np.
30	10·4	Mimas	nf.

1879.	Gr. M. Time. h.		
30	11·0	Dione	sp.
31	7·5	Encel	sp.
	9·0	Mimas	nf.
	14·0	Encel	sf.
Nov. 1	7·6	Mimas	nf.
	7·7	Dione	np.
	8·7	Rhea	sup. s.

A. M.

JUPITER.

1879.	Angle of position of 4's axis.	Latitude of Earth above 4's equator.	Latitude of Sun above 4's equator.	Equat. diameter.	Greatest phase.
	°	°	°	″	″
Oct. 7	336·51	+1·28	+1·34	46·80	0·20
17	336·61	1·24	1·38	45·58	0·27
27	336·65	+1·20	+1·43	44·25	0·34

The assumed First Meridian passes the middle of the illuminated disk at the following times:

1879.	G. M. T. h. m.
Oct. 1	5 3·3
	14 58·7
2	0 54·2
	10 49·6
	20 45·0
3	6 40·4
	16 35·9
4	2 31·3
	12 16·8
	22 22·2
5	8 17·6
	18 13·1
6	4 8·5
	14 4·0
	23 59·4
7	9 54·8
	19 50·3
8	5 45·8
	15 41·2
9	1 36·7
	11 32·1
	21 27·5
10	7 23·0
	17 18·4
11	3 13·9
	13 9·4
	23 4·8
Oct. 12	9 0·3
	18 55·7
13	4 51·2
	14 46·7
14	0 42·1
	10 37·6
	20 33·0
15	6 28·5
	16 24·0
16	2 19·5
	12 14·9
	22 10·4
17	8 5·9
	18 1·4
18	3 56·8
	13 52·3
	23 47·8
19	9 43·3
	19 38·7
20	5 34·3
	15 29·7
21	1 25·2
	11 20·7
	21 16·2
22	7 11·7
	17 7·1
Oct. 23	3 2·6
	12 58·1
	22 53·6
24	8 49·1
	18 44·6
25	4 40·1
	14 35·6
26	0 31·1
	10 26·6
	20 22·1
27	6 17·6
	16 13·1
28	2 8·6
	12 4·1
	21 59·6
29	7 55·1
	17 50·6
30	3 46·1
	13 41·6
	23 37·1
31	9 32·6
	19 28·2
Nov. 1	5 23·7

A. M.

ASTRONOMICAL OCCURRENCES FOR OCTOBER, 1879.

DATE.		Principal Occurrences.	Jupiter's Satellites.		Meridian Passage.
		h. m.		h. m. s.	h. m.
Wed	1	10 3 Occultation of 101 Piscium (6)	1st Ec. R.	6 44 3	Jupiter.
		11 17 Reappearance of ditto			—
					9 45·0
Thur	2	Sidereal Time at Mean Noon 12h. 43m. 19·94s.	2nd Ec. R.	8 17 8	
			3rd Oc. D.	10 39	9 40·7
Fri	3	Sun's Meridian Passage 10m. 53·48s. before Mean Noon			9 36·5
Sat	4	10 33 Occultation of 36 Tauri (6)			
		11 39 Reappearance of ditto			9 32·2
		8 Conjunction of Moon and Mars 5° 45′ S.			
Sun	5	11 16 Occultation of k Tauri (5½)			
		12 19 Reappearance of ditto	1st Tr. I.	13 44	9 28·0
		11 Saturn at opposition to the Sun			
Mon	6	10 45 Near approach of 132 Tauri (5½)	3rd Sh. E.	7 28	
			1st Oc. D.	11 2	9 23·8
			1st Ec. R.	14 10 37	
Tues	7	15 28 Occultation of B.A.C. 2238 (6)	1st Tr. I.	8 11	
		16 29 Reappearance of ditto	1st Sh. I.	9 4	
		0 Conjunction of Jupiter and σ Aquarii 0° 10′ N.	1st Tr. E.	10 30	
			1st Sh. E.	11 23	9 19·6
		Saturn's Ring:	1st Tr. I.	12 0	
		Major axis=44″·51	2nd Sh. I.	13 46	
		Minor axis= 6″·76			
Wed	8	1 43 ☾ Moon's Last Quarter	1st Oc. D.	5 29	
			4th Oc. D.	6 36	
			1st Ec. R.	8 39 34	9 15·4
			4th Oc. R.	10 56	
Thur	9		1st Sh. E.	5 52	
			2nd Oc. D.	6 15	
			2nd Ec. R.	10 53	9 11·2
			3rd Oc. D.	14 6	
Fri	10				9 7·0
Sat	11	16 48 Occultation of B.A.C. 3529 (6)	2nd Sh. E.	5 57	9 2·9
		17 35 Reappearance of ditto			
Sun	12				8 58·7
Mon	13	3 Conjunction of Moon and Venus 0° 51′ S.	3rd Sh. E.	7 31	
			3rd Sh. I.	7 58	
			3rd Sh. E.	11 30	8 54·6
			1st Oc. D.	12 50	
Tues	14		1st Tr. I.	9 59	
			1st Sh. I.	10 59	
			1st Tr. E.	12 18	8 50·4
			1st Sh. E.	13 18	
Wed	15	15 ● New Moon			
		18 Conjunction of Moon and Mercury 5° 19′ N.	1st Oc. D.	7 17	
		Illuminated portion of disc of Venus=0·130	1st Ec. R.	10 35 8	8 46·3
		Illuminated portion of disc of Mars=0·956			

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
				1st Sh. I.	5 28	Jupiter.
				1st Tr. E.	6 45	—
Thur	16		Sidereal Time at Mean Noon 13h. 38m. 31·69s.	1st Sh. E.	7 47	8 42·2
				2nd Oc. D.	8 37	
				2nd Ec. R.	18 29 14	
Fri	17		Sun's Meridian Passage 14m. 32·02s. before Mean Noon	1st Ec. R.	5 3 59	8 38·1
				4th Sh. E.	6 13	
				2nd Sh. E.	5 44	
Sat	18			2nd Tr. E.	6 29	8 34·1
				2nd Sh. E.	8 35	
Sun	19					8 30·0
		7 46	Occultation of B.A.C. 6369 (6)	3rd Tr. I.	7 32	
Mon	20			3rd Tr. E.	11 7	8 25·9
		8 24	Reappearance of ditto	3rd Sh. I.	12 1	
Tues	21	18 18	☽ Moon's First Quarter	1st Tr. I.	11 48	8 21·9
				1st Sh. I.	12 54	
Wed	22			1st Oc. D.	9 6	8 17·9
				1st Ec. R.	10 30 46	
				1st Tr. I.	6 15	
				1st Sh. I.	7 23	
Thur	23			1st Tr. E.	8 34	8 13·9
				1st Sh. E.	9 42	
				2nd Oc. D.	11 0	
		7 12	Occultation of θ Aquarii ($4\frac{1}{2}$)			
Fri	24	8 27	Reappearance of ditto	3rd Ec. R.	5 20 51	8 9·9
		13	Conjunction of Moon and Jupiter 5° 17′ S.	1st Ec. R.	6 59 37	
				2nd Tr. I.	6 3	
				2nd Sh. I.	8 22	
Sat	25			2nd Tr. E.	8 55	8 5·9
				4th Ec. D.	9 34 29	
				2nd Sh. E.	11 14	
Sun	26					8 1·9
		18	Conjunction of Moon and Saturn 8° 22′ S.			
Mon	27		Saturn's Ring: Major axis=44″·14 Minor axis= 6″·22	2nd Ec. R.	5 23 49	7 58·0
				3rd Tr. I.	11 12	
Tues	28					7 54·0
Wed	29	14 9	○ Full Moon	1st Oc. D.	10 57	7 50·1
		10 11	Near approach of 47 Arietis (6)			
		11 13	Occultation of ε Arietis ($4\frac{1}{2}$)	1st Tr. I.	8 5	
Thur	30			1st Sh. I.	9 18	7 46·1
		11 43	Reappearance of ditto	1st Tr. E.	10 25	
		15	Venus at greatest brilliancy	1st Sh. E.	11 37	
				1st Oc. D.	5 25	
				3rd Ec. D.	6 3 58	
Fri	31			1st Ec. R.	8 55 17	7 42·2
				3rd Ec. R.	9 22 17	
NOV.				1st Tr. E.	4 52	
				1st Sh. E.	6 6	
Sat	1			2nd Tr. I.	8 32	7 38·3
				2nd Sh. I.	11 1	
				2nd Tr. E.	11 24	

THE PLANETS FOR OCTOBER.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury...	1st	12 24 40	S. 1 4	4″·8	23 41·4
	9th	13 8 44	S. 6 25½	4″·8	* *
	17th	13 57 19	S. 12 4½	4″·8	0 14·8
	25th	14 33 14	S. 15 40½	4″·8	0 31·1
Venus ...	1st	11 32 40	S. 5 14	56″·5	22 49·5
	9th	11 25 0	S. 2 40	53″·2	22 10·4
	17th	11 26 49	S. 0 55	44″·4	21 40·8
	25th	11 37 10	S. 0 11½	42″·9	21 19·7
Mars ...	1st	3 47 18	N.18 30½	19″·6	15 5·4
	9th	3 47 24	N.18 24	20″·8	14 34·1
	17th	3 43 31	N.18 31½	21″·8	13 58·7
	25th	3 35 54	N.18 30	22″·6	13 19·7
Jupiter ...	1st	22 25 57	S. 11 19	44″·9	9 54·0
	9th	22 23 37	S. 11 31	44″·1	9 11·2
	17th	22 22 1	S. 11 39	43″·1	8 38·1
	25th	22 21 13	S. 11 42	42″·1	8 5·9
Saturn ...	1st	0 50 46	N. 2 28½	17″·8	12 9·4
	9th	0 48 28	N. 2 14	17″·8	11 35·6
	17th	0 46 11	N. 1 59½	17″·8	11 1·9
	25th	0 44 1	N. 1 46½	17″·8	10 28·3
Neptune ...	4th	2 38 19	N.13 31½	...	13 44·8
	20th	2 36 44	N.13 23½	...	12 40·4

Mercury is too close to the sun to be well observed.

Venus rises about three-quarters of an hour before the sun, on the 1st, the interval rapidly increasing.

Mars is visible throughout the night, rising about half-an-hour after sunset, the interval increasing.

Jupiter is visible after sunset till about three hours after midnight, at the beginning of the month, the interval decreasing.

Saturn rises about sunset on the 1st, and is visible through the night, and then earlier each day. He sets about two hours and a half before sunrise at the end of the month.

THE SATELLITES OF MARS, 1879.

Angle of position p_o of the major axes of the apparent ellipses described by the satellites, and major and minor semi-axes a b expressed in semi-diameters of the planet's disk, and also in seconds of arc, a'' b''.

		Phobos.				Deimos.			
oh. Gr.	p_o	a	b	a''	b''	a	b	a''	b''
	°			″	″			″	″
Oct. 1	54·14	2·77	0·46	22·83	3·77	6·94	1·15	57·14	9·43
11	54·10		0·47	24·50	4·17		1·18	61·31	10·43
21	53·81		0·52	25·91	4·84		1·29	64·84	12·10
31	53·35	2·77	0·59	26·72	5·68	6·94	1·48	66·86	14·22

Deimos will be at its greatest elongations ("nf." in position angle 54° and "sp." in pos. 234°) about the following times:

G.M.T.	h.			h.			h.			h.	
Oct. 1	3·9	nf.	Oct. 9	8·8	sp.	Oct. 17	13·7	nf.	Oct. 25	3·4	nf.
	19·0	sp.	10	0·0	nf.	18	4·8	sp.		18·5	sp.
2	10·2	nf.		15·1	sp.		20·0	nf.	26	9·6	nf.
3	1·1	sp.	11	6·2	nf.	19	11·1	sp.	27	0·8	sp.
	16·5	nf.		21·4	sp.	20	2·2	nf.		15·9	nf.
4	7·1	sp.	12	12·5	nf.		17·4	sp.	28	7·0	sp.
	22·8	nf.	13	3·7	sp.	21	8·5	nf.		22·2	nf.
5	13·9	sp.		18·8	nf.		23·7	sp.	29	13·3	sp.
6	5·1	nf.	14	10·0	sp.	22	14·8	nf.	30	4·4	nf.
	20·2	sp.	15	1·1	nf.	23	5·9	sp.		19·6	sp.
7	11·4	nf.		16·3	sp.		21·1	nf.	31	10·7	nf.
8	2·5	sp.	16	7·4	nf.	24	12·2	sp.	Nov. 1	1·8	sp.
	17·7	nf.		22·5	sp.					17·0	sf.

About 5·6 hours before and after the times of greatest elongations Deimos will be at the distance of one diameter of the disk from the edge of the disk, and about 3·8 hours before and after the greatest elongations at the distance of two diameters. In 1877 it has not been seen nearer than $1\frac{1}{6}$ diam. from the edge. The brighter inner satellite Phobos has been observed at a distance of only $\frac{1}{2}$ diam., and as it remains outside this limit for 2·3 hours in every half-revolution of 3·8 hours, its vicinity to the planet will not be a cause of invisibility, if the search is spread over a couple of hours.

P.S.—Mr. Common has succeeded in re-observing Deimos late in the night of Sept. 21, by means of his newly erected silver on glass reflector of three feet diameter, at present, probably, the most powerful telescope in England. According to a list of the times of greatest elongations for September, Deimos was expected to be at its "sp." elongation on Sept. 21, about 16·5h. Mr. Common's observed position angles indicate that the satellite is not advanced in its orbit quite so far as the prediction gave it, and that the computed period of revolution will have to be lengthened by a few seconds, but the true amount of the correction required can only be settled by subsequent observations. Under the circumstances, the correction of the times of greatest elongations for October cannot be given at present; it may possibly amount to an hour to be added.

A. M.

MARS.

Mädler's spot "*a*" of 1830, designated on Mr. Green's chart of Mars in Vol. xliv. of the *Memoirs* of the Royal Astronomical Society, as "Dawes' Forked Bay," will pass the central meridian of the planet's disk about the following times:

1879.	h.		h.		h.
Oct. 19	7·2	Oct. 25	10·8	Oct. 30	13·9
20	7·8	26	11·4	31	14·5
21	8·4	27	12·0	Nov. 1	15·1
22	9·0	28	12·7	2	15·7
24	10.2	29	13·3		

For settling the question of the planet's rotation it is essential that the passages of this spot across the diameter of the disk, laid through the centre of the polar spot, should be carefully observed, and the times

given, when it is "not quite up yet," and "just past." Mädler, using a refractor of only 3·8-in. aperture, could not discern details, and observed the spot as a round patch. To make the corresponding observations, no bigger telescope would be necessary, provided the estimations are made with proper care and circumspection. A. M.

OBSERVATORY ON MOUNT ETNA.

Sicilian papers state that the erection of the astronomical-meteorological observatory on Mount Etna, on the site of the Casina degli Inglesi, is already commenced. Professor Tacchini laid the project before the commune of Catania, and it is also supported by the minister for agriculture and commerce. We believe that a 12-in. refractor is to be furnished by Merz, and that astronomers from other countries will have facilities for observing there. Meteorological and seismological observations will be carried on, and the clearness of the atmosphere will be an immense advantage for telescopic and other work. The Casa degli Inglesi, or English House, about 9,600 feet above the sea level, is so called from a building raised by the English during their occupation of Sicily in 1811. The Etnean Observatory will form part of the extensive network of meteorological stations of Italy which is under the above-named minister.

Erratum.—Sept. No., page 212, line two, for *like* read *live*.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To June, 1879.	**To Dec., 1879.**	**To June, 1880.**
Pratt, H.	Gray, T. P.	Gooch, Miss
To Sept. 1879.	**To Jan. 1880.**	**To Sept., 1880.**
Lewis, H. K.	Shaw, Rev. J.	Jones, W. E.

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The Astronomical Register.

No. 203. NOVEMBER. 1879.

HYGINUS N.—(Continued).

By E. Neison.

The new year opened with weather as unpromising for astronomical work as that of the last year, though bidding fair to be liberal enough in snow and rain, and well have these anticipations been realised.

The first observation of the new year may be said to be that of Mr. D. W. Edgecumb, of Hartford, Conn., U.S. of America, who observed the moon with his $9\frac{1}{2}$-inch Alvan-Clark refractor, between eight and nine p.m. on the night of December 31st, 1878, local mean time, which would correspond to between one a.m. and two a.m. on January 1st, 1879, Greenwich civil time, and so may be regarded as coming within the present year. The observation is as follows:

December 31st, 1878. Terminator —3° to —4°. Edgecumb. Hyginus N seen as a black circular depression, about 2″·5 in diameter. It is drawn as a distinct object.

The next observation is one by Mr. Rand Capron, and was made under high illumination.

January 4th, 1879. Terminator —50°. Rand Capron. A dull dark spot was seen with a suspicion of a brighter margin, and much larger than the crater.

From the drawing made by Mr. Rand Capron there can be no doubt but that this spot was not N, but was the large slightly depressed spot to the west of N, which being slightly darker than the surrounding bright streaks, appears like a rounded greyish spot, under high illumination. Mr. Rand Capron subsequently

recognised this himself, and it has been independently noted by Mr. N. E. Green. This leaves little doubt as to the character of the spot seen by Mr. Baxendell and mistaken by him for N.

As the year wore on, although the weather became worse for general astronomical purposes, it improved in one way, it no longer became persistently cloudy at the day of first quarter and last quarter. It was this extraordinary coincidence which had so effectually baffled observers, for there had been many fine days between.

On February 28th, although the weather was cloudy in the south of England, it was tolerably fine in the north, and also fine in the south of France. The region was drawn by M. Gaudibert at Vaison, with his 8½-inch reflector, and by Mr. Baxendell at Birkdale with his 6-inch refractor.

February 28. 1879. Terminator +1° to —1°. Gaudibert. Hyginus N seen and described as the most striking object between Hyginus, the spiral mountain and the crater C. It appeared like a roundish spot, about one-third the diameter of Hyginus, and dark grey in colour.

February 28, 1879. Terminator +0° to —1°. Baxendell. Hyginus N seen as a very dark, though not absolutely black spot.

Mr. Baxendell shows N in its true place, but M. Gaudibert apparently places it too far west, and draws between N and the spiral mountain a large flat whitish mound, and places the western part of this mound almost exactly where all other observers see a valley. It is possible, however, that this mound, only drawn too wide, is intended for the western arm of the spiral mountain; if so, this would bring this drawing of M. Gaudibert into much closer accord with those of other observers. It is this want of exactness in the delineation of this region which has rendered M. Gaudibert's drawings so perplexing, for some of his different drawings show a difference in the relative positions assigned to different objects which it is impossible for any alteration in libration or illumination to produce.*

On March 1st I succeeded in obtaining my first view of this

* To particularise. In one drawing dated Sept. 18, 1878, taking the diameter of Hyginus at four miles, the distance from Hyginus to the crater *s* is made seven miles, and from the crater *s* to the crater *x* as four miles, or about half the distance. Yet on another drawing, dated Feb. 28, 1879, again taking the diameter of Hyginus as four miles, the distance of Hyginus to the crater *s* is made as nine miles, and from *x* to *s* as 12 miles, or more than twice as far away as before. In yet a third sketch, dated March 30, 1879, the distances are 12 miles and 10 miles respectively. Now, it is true that differences in libration will

region under anything like suitable illumination. On the same day the moon was also observed by Mr. Baxendell and Captain Noble.

March 1st. Terminator —10° to —12°. Baxendell. Hyginus N well seen with 4-inch aperture. With 6-inches it appeared smaller and much less dark than last night. At 10h. the crater is sensibly less dark since $7\frac{1}{2}$h., and has now an irregular oval shape.

March 1st. Terminator —10° to —11°. Noble. Klein's crater was seen as an ovoid marking, very slightly darker than the surrounding field, and scarcely, if at all, larger than Hyginus itself.

March 1st. Terminator —10° to —11°. Neison. Hyginus N was seen as an ill-defined black spot, slightly oval in shape, and having no resemblance to a crater, but sufficiently conspicuous to at once attract my attention. It had no trace of any white border, but on the east it was bordered by a brighter marking, which I at once recognised to be a low ridge which I had often seen in my earlier observations. Close to the blackish spot was a white elevation, apparently a hill, it was on the south-east border of the spot. In all respects than the presence of this dark spot, the appearance of this region exactly resembled its aspect as I had seen it during 1874—75 when constructing my map.

The observation was of considerable interest to me, for it convinced me that there was one object in this region which I had not seen in my earlier observation. Had or had I not overlooked it? That was the question, and one which I was then unable to answer. It will be seen that my observation confirms Mr. Baxendell's.

I awaited the next day with some curiosity. It proved to be fine, and I obtained a fine view of the moon. Mr. Baxendell also observed the moon.

March 2nd. Terminator —23°. Baxendell. The crater no longer appears either as a round or oval-shaped spot, but on its place, and extending nearly to the crater *s* there is a dusky marking, but little less bright than the surrounding district.

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slightly alter the relative distances of these objects, but it is an easy trigonometrical calculation to find out by how much, and it will be found that they cannot differ much more than 0·1 mile. In sketching lunar formations it is essential to take care to place the different formations in their correct relative places.

March 2nd. Terminator —22° to —24°. Neison. Though most carefully looked for, not a trace of Hyginus N could be seen. Of this I am certain: in the position where on the previous day I had seen the dark spot, not a trace of any such object could be seen. In this neighbourhood, however, there were three rounded faint dark spots to be seen. These faint dark spots, however, were merely portions of the surface which were marked out by the light streaks radiating from the streaks *x* and *s* and the hill *h*. They were familiar to me, as I had mapped them five or six years before.

This observation is interesting, for to me it appears conclusive that Mr. Baxendell mistook one of the rounded dark spots near N for N itself. If N had really been visible, as Mr. Baxendell supposed, I do not see how I could have overlooked it, for the air was steady and I had by far the more powerful telescope. Yet if on this day Mr. Baxendell mistook a neighbouring object for N, it is not unlikely that he may have done so on other similar occasions, and thus confirm the interpretation I have put on his previous observations under high illumination. During this observation I at once recognised Mr. Rand Capron's dark spot, as the northernmost of the dark spots seen by me.

On March 3rd, the night being again fine, I carefully examined the region near Hyginus. It was also examined by Mr. Baxendell.

March 3rd. Terminator —39°. Baxendell. Hyginus N was completely invisible.

March 3rd. Terminator —36° to —37°. Neison. Hyginus N was completely invisible, but the other dark spots were distinct enough. I could detect no difference between the appearance of this region as now visible and as it appeared when making my drawings in the years 1874—75 and when I was making my tint observations.

As the illumination on this day was about the same as at the epoch of the Rutherfurd and Melbourne lunar photographs, these observations were most important, showing, as they did, that N was completely invisible umder this illumination, thus confirming the observations of Dr. Klein.

During the next few days Mr. Baxendell was enabled to continue his observations, though, unfortunately, important engagements prevented me continuing mine.

March 4th. Terminator —49°. Baxendell. There is a moderately bright spot on or very near the place of the crater; it is less bright than either of the two small craters to the south-west. Images unsteady. Day cloudy.

March 5th. Terminator —62°. Baxendell. There is a faintly bright spot on the place of the new crater. N appears to be elongated or rudely shaped, like the figure 8.

March 6th. Terminator —73°. Baxendell. Klein's crater is still visible, slightly brighter than the surrounding ground.

March 8th. Terminator +81°. Baxendell. Klein's crater very distinctly visible.

The tenor of these observations would seem to show that Klein's crater (Hyginus N) was visible under high illumination as a white spot, contrary to what was stated by Dr. Klein. I have no doubt though that what was really seen by Mr. Baxendell was the spot to the south of N, almost on its border, in fact. This spot agrees exactly in appearance with Mr. Baxendell's description, and is so close to the place of N that it could readily be mistaken for it. As it happened, I was unable to observe the moon on these days, but an observation I did obtain shows, I think, conclusively that what was seen by Mr. Baxendell was not N.

March 7th. Terminator —85°. Neison. The region near Hyginus was most carefully drawn. Not the slightest trace of Hyginus was visible, though the dark spot seen by Mr. Rand Capron could be easily identified. South of the place of N was a distinct white oval spot, evidently due to the white hill *t* on the south of N.

On Monday 7th, therefore, N was invisible, and the only white spot was that to the south, but this must have been the white spot seen by Mr. Baxendell on both the previous and subsequent days, for it cannot be supposed that on this intermediate day N disappeared from view and a new white spot came into view only to vanish again on the next day.

The next favourable occasion for observing Hyginus was March 29, 1879, when it would be on the terminator shortly before 8 p.m., more than five hours before the moon set, and when the moon would be still high above the horizon. The day arrived, but was not promising, though the sun shone through the clouds at intervals, but towards evening, as I came through Hyde Park, the appearance of the sky gave every presage of yet another disappointment, and, surely enough, after sunset dense clouds came over the heavens and effectually hid all from view, so that I went into dinner without the remotest hope of seeing anything that night. Shortly before ten, however, the thick clouds cleared away, and I was enabled to turn my telescope on the moon.

Hyginus itself was not visible, but a rapid glance enabled me

to take in the principal points of importance. In the place of Hyginus could be seen an irregular depression, half filled with shadow, but there was nothing novel in this as I had long known that Hyginus lay in such a depression. Running towards the west out of this depression was the western arm of the great rill of Hyginus, looking like a gigantic irregular gorge, and utterly unlike a chain of craters, whilst in the faintly illuminated region, close to the terminator, there could be dimly discerned the broader but shallower eastern arm of the rill. On the east close to the terminator could be seen the wild mountain region called the Schneckenberg by Beer and Mädler, with its numerous crests and peaks casting broad and long masses of shadow. On the north were the lofty mountain ridges bordering the deep dark valleys of this district. Between these regions lay a broad plain broken by several small craters, with their interiors still immersed in shadow, whilst scattered here and there about this plain were a number of low hills and ridges casting short shadows or half shadows. From Hyginus, or rather the irregular depressions surrounding Hyginus, there ran a broad curved valley still partially immersed in shadow, bordering the Schneckenberg on the west, and disappearing in the shadow cast by the peaks of the mountains to the north of the plain.

Where, however, was Hyginns N, the object described by Dr. Klein as a great deep conspicuous crater? No such object was there. I was for the moment surprised, for after what had been observed by other observers I had fully expected to see it standing out conspicuously on the outer western border of the valley bordering the Schneckenberg. I ran my eye along the border of this valley, but nothing could be seen. No, nothing; stay, there is something, but not on the outer border of the valley but within the valley on its western slope. Closer examination showed that there was a dark, almost black, slightly elliptical spot on the inner slope of this valley. But it lay right within the half shadow nearly filling the valley, and it was difficult to make out what was its real nature. Of its existence there could be no doubt, of its true nature nothing could be seen, but it seemed to answer tolerably well to what might be anticipated would be the appearance of Hyginus N seen under similar conditions.

The half shadow which prevented the satisfactory observation of this region, could not last more than a couple of hours and I then anticipated being able to satisfactorily make out the true nature of this object. If it was really of the nature described by Dr. Klein, it would then stand out clearly and distinctly as a conspicuous deep black crater. As the moon would not set for nearly three hours, there was plenty of time. I continued to observe

the region, and made a careful sketch; every minute the dark object, which I had now no doubt was N, coming more distinctly into view. Suddenly a broad black mass came sailing steadily into the field of view. It gave me a shock, for it was totally unexpected, though I at once recognised my ominous visitor. It was a dense cloud.

Looking out, I found that a dense bank of clouds was coming up from the horizon, so that though the moon shone for a short time through some small breaks, it soon finally disappeared behind the dense masses of cloud, and was no longer visible during that night.

Although, therefore, I had failed to obtain a good view of the supposed new crater Hyginus N, I had been far more successful than at any previous attempt. I had been able to satisfy myself that there did exist in this part of the moon a dark crater-like object which I had never previously seen. Whether it was too distinct to be overlooked was a question I could not settle, having been again baffled by the clouds.

A day or two afterwards I learnt that on the same evening this portion of the moon had been observed by Messrs. J. L. and J. McCance, at Putney, using a $5\frac{1}{4}$-inch reflector. They had also seen the dark spot near Hyginus, and at once recognised my drawing as well representing what they had seen. On the same evening Mr. Nath. E. Green observed the region, and made a series of drawings. He did not recognise Hyginus N, being unable to see any very conspicuous dark crater in this region. Subsequently, on comparing his drawing with mine, they were found to be in close agreement, and there on his drawing lay the same dark elliptical spot seen by myself, but which he had failed to identify with N, supposing N to be further west. These observations may be summed up as follows:

March 29. Terminator $+6°$. Messrs. McCance, Green, and Neison. Hyginus N seen as a blackish oval spot on the inner slope of a slight curved valley on the west border of the Schneckenberg.

On the succeeding evening an unavoidable engagement kept me away, and I was unable to observe the moon. This region was observed, however, by Mr. Green and by M. Gaudibert.

March 30. Terminator $-4°$. Green. Hyginus N was seen as a dark, ill-defined spot, having no resemblance to a crater.

March 30. Terminator $-5°$. Gaudibert. Hyginus N seen as a dark oval spot on the slope of valley. It is shown apparently further from the spiral mountain than any

other observer draws it, but if, as is not impossible, the low mound drawn by M. Gaudibert, is really intended for the western arm of the spiral mountain, then M. Gaudibert's drawing is in exact accordance with the other observers.

The next evening when Hyginus N could be observed was April 28th, 1879, and if fine it would be still more favourable than on the last occasion, for the crater would be lying open on the plain, and if it really possesses the character assigned to it by Dr. Klein, it should be visible as a conspicuous deep black crater-like spot, nearly three miles in diameter, and far too distinct to be overlooked.

The day opened badly enough, but improved towards mid-day, only to cloud over again towards evening. I had been calling on a friend in London, and left shortly before six o'clock. As I stood on the doorstep I critically examined the sky, and never saw anything more unpromising. The sky was densely overcast, and lower lying blacker masses were slowly crossing the heavens, whilst right across the other side of the square I could see them densely packed. The wind was gusty, and looking at the pavement I could see that it had been raining a little. It was a great disappointment, for I knew I could not observe in either the May or June lunations, as I should be miles away. And after the June lunation I knew that it would be nearly November before the moon would be again well placed for observation under this illumination.

As I strolled down to St. James' Street, where I intended to obtain some dinner at my club, I continued to watch the sky, but it became worse, if possible, and I gave up all chance of seeing the moon that night. I knew that once I had obtained a fair night for an important observation, after an unpromising evening, but then that is a thing which happens only once or twice in a lifetime. However, I thought I would give it one more chance, so at nine I sent out to see what the weather was like, and received the expected news that it was "raining, sir." That settled the matter, and I had to make up my mind to wait yet another half year for my chance of seeing Klein's supposed new crater.

It was about half-past ten as I left the club, and as I came down the steps, to my amazement, I saw the moon brightly reflected from the windows of the houses on the opposite side of St. James' Street. Quickly crossing the street into Pall Mall, I looked up, and there over St. James' Palace, was the moon shining as quietly as possible, and not a cloud in sight. I afterwards learnt that the clouds had not cleared off for more than ten minutes when I came out. To jump into a Hansom and come

along at top speed was the work of merely a moment, for I saw that I had little time to spare, the moon was within two hours of the horizon, and for the last half-hour was not visible from my temporary observatory.

I was but just in time, for as I got everything in order I threw a glance at the moon, and found I had barely half-an-hour's time to observe. Putting my eye to the telescope, a push in right ascension and a pull in declination brought Hyginus central in the field of the telescope, and then in the open plain, to the immediate north of Hyginus, *was a great black crater-like object, nearly as large as Hyginus, and far too conspicuous to be overlooked, standing in the very midst of a region in which I was certain no such object was visible in my numerous early observations of this region.*

There could be no mistake, the object was so distinct that it would have been impossible to have overlooked it and yet seen any of the smaller objects in its neighbourhood. It agreed well with Dr. Klein's description, having all the appearance of being a black crater pit, surrounded by a nebulous border, and of a type with which I was perfectly familiar from my observation of the similar formation a thousand miles away in the south-west quadrant of the moon. At last I had been rewarded.

I roughly drew the appearance of the region, but had not time to quite complete my drawing when the moon sunk out of my sight. Had I been twenty minutes later it would have been too late.

A couple of days or so later, I went over to the Royal Astronomical Society and there met Capt. Noble, Mr. Sadler, and, I think, Mr. Gore. I showed them my drawing. None of them had observed the moon that night, having given it up in despair. Whilst there Mr. Green came in, and brought with him a drawing he had made on the same night, April 28th. Mr. Sadler, Mr. Green and myself compared the drawings, and they agreed perfectly. Mr. Green agreed with me in saying that the crater was far too conspicuous to be overlooked. I afterwards learnt that Dr. Klein had seen and drawn this region on the same night, and that his drawing agrees completely with those made by Mr. Green and myself.

There could no longer be any doubt in the matter. In the open plain to the north of Hyginus there now exists a great black conspicuous object, which could not have been overlooked by and was never seen by any of the astronomers who observed the moon prior to the year 1877.

(*To be continued.*)

REVIEWS.

Report of the Oxford University Observatory. Read to the Board of Visitors on June 4th, 1879. From the Oxford University Gazette, June 10th.

Besides the delivery of lectures on the astronomy and astronomical instruments of Ptolemy and Hipparchus, and instruction in the use of instruments, the Savilian professor reports that forty of the stars in the Pleiades have been observed with the large equatorial, and the new duplex micrometer, for the purpose of ascertaining proper motions, by comparison with Bessel's observations, and testing the capabilities of the micrometer by comparison with the far more costly heliometer. Nearly 300 photographs of the moon have been taken with the De La Rue reflector, which prove to be reliable for minute and delicate measurements. Thus sixteen of them have afforded a provisional determination of the moon's semi-diameter, which differs from the *Nautical Almanac* value only by 0.118″. The periodical comets of Tempel and Brorsen have been observed. By the usual generosity of Dr. De La Rue one of Mr. With's silver on glass mirrors of 13-in. aperture, has been excellently re-figured by that skilful artist. These are only some of the items of the work done, which the Savilian professor trusts may be accepted as evidence of the activity of the observatory, and of the realisation of the objects for which it has been established, and of this we think there can be no doubt. We look forward with interest to the forthcoming fasciculus of observations. The very loyal and able co-operation of the two assistants, Mr. Plummer and Mr. Jenkins, is cordially acknowledged.

VICTORIA.

Thirteenth Report of the Board of Visitors to the Observatory; together with the Annual Report of the Government Astronomer. Presented to both Houses of Parliament by His Excellency's command. John Ferres, Government Printer, Melbourne.

Besides other interesting details of this important observatory, we learn from Mr. Ellery's report, which refers to the period between 22nd May, 1877 and 30th June, 1878, that an unavoidable delay has occurred in the publication of the large and valuable series of drawings of nebulæ observed with the Great Telescope; but it will be completed as soon as possible. Mr. Simms has presented a good solar spectroscope to the observatory. The Mars observations will soon be ready for distribution. Very successful observations of the planet were obtained on 67 nights. Besides a large amount of other work, several hundred measures of southern double stars have been made; also a fine series of measures of the polar and equatorial diameters of Mars during opposition, and numerous measures of Saturn's ring. There were but 75 nights upon which observations of the nebulæ could be made. 77 of the smaller nebulæ in Sir John Herschel's general catalogue have been observed. The present aspect of many of these agree almost exactly with Herschel's description, others are considerably changed, and some are so completely altered as to be only recognised by their position. Two nebulæ, H 4223 and H 1561, widely separated from each other, and described by Herschel as prominent objects, cannot now be found, although careful search has been made for them. The nebulæ round η Argûs has been, on six evenings, compared with the drawings of March, 1875. The only change detected is a break or separation in one of the branches on the preceding

side. This has been clearly established. Observations of the satellites of Uranus were obtained on sixteen occasions, and a diligent, but unsuccessful, search was made for the satellites of Mars on sixteen nights. Mr. Turner has also made several fine coloured drawings of Mars and Jupiter at their oppositions.

Mr. Ellery says: "On the 24th September last year, I received a telegram from Sir George Airy, requesting us 'to watch Mars for suspected satellites,' but unfavorable weather prevented more than a partial compliance with this request. On the 11th of October, however, a telegram announced that the satellites had actually been discovered by means of the great refractor at Washington. At this time our great telescope was crippled by the breaking of the declination clamp, and it was not until the 16th that we could commence our search for the newly-discovered bodies. Mars had by this time increased his distance from the earth so much, that our failure to find them might be thus accounted for. There can be no doubt that the smaller of the two satellites was seen on one occasion, but clouds interfered before its identity could be verified. Although we were so late in the field, our failure to find these bodies with certainty and ease is somewhat unaccountable."

The cost of a new and larger transit circle, which is much wanted, it appears would be about £1,200, and it would take two years in constructing. One has lately been erected at the Sydney observatory; and it is hoped that the Government of Victoria, with its accustomed liberality towards the observatory, will soon grant the requisite means.

Stonyhurst College Observatory. Results of Meteorological and Magnetical Observations, 1878. Manresa Press, Roehampton, 1879. pp. 62.

We are always glad to see this excellent little annual with, in addition to its careful scientific records, its agricultural notes, and observations of crops and flowers and of trees and shrubs. Father Perry arranges his matter in a pleasing and compact form, easy to examine. We find that the reduction of the meteorological observations at Kerguelen Island, during the Transit of Venus expedition has been completed, and together with a discussion of the *Challenger* observations in 1874, and of the *Erebus* and *Terror* observations in 1840, will be published by the meteorological office. A large automatic spectroscope is a late important addition to the observatory, with which it is intended to keep as nearly as possible a daily record of the number, shape, and position of the prominences of the chromosphere. We rejoice that the object glass of the large equatorial has been much improved in definition since it was repolished by MM. Troughton and Simms. The Manila observatory has been aided with instruments, &c., and yearly reports of that distant station have been published since 1870. A series of magnetic and meteorological observations are to be made in connection with the new Jesuit missions in the South of Central Africa.

Navigation and Nautical Astronomy. With special table, diagram, and rules adapted for navigating iron ships. By Rev. W. T. Read, M.A., Head Master and Chaplain, Thames Nautical Training College, H.M.S. "Worcester." London: Elliot Stock, Paternoster Row, 1879. pp. 230. 10s. 6d.

Contents are—Part I., Navigation. Part II., Nautical Astronomy. Part III., Investigations of Rules, and examples for exercise, with answers. There are no tables supplied, but those of Riddle are especially recommended, which have been used in the compilation of the work. It is a representation of the course which has been uniformly adopted

in the training of Mercantile Marine Cadets on board H.M.S. "Worcester," over the mathematical instruction of whom the author has presided since the institution of the College, and he offers it as the result of many years experience in the teaching of theoretical navigation and astronomy. He trusts that it may be found serviceable both to navigating officers and to pupils in course of training in navigation schools generally. As far as we have examined this work it seems to us clear, complete, and well drawn up. The author's experience as a teacher must have been of great advantage to him in its compilation. The department of nautical astronomy is often of interest to others than professional men,—passengers in ships, and travellers by land, for instance. This part reminded us of many a pleasant night-watch in the tropics, on board one of the old East India Company's ships, when we used to assist the skilful officers (for whom that service was noted) in the taking of lunars, &c. Part III. is very important. The mere mechanical working of rules, without a knowledge of the trigonometrical processes from which they are derived, is not at all satisfactory.

Key to the Universe, or a New Theory of its Mechanism. Founded upon a—I. Continuous Orbital Prepulsion, arising from the velocity of gravity, and its consequent aberrations; II. Resisting Ethereal Medium, of variable density. With mathematical demonstrations and tables. By Orson Pratt, sen. W. Budge, Islington, Liverpool. pp. 118. 6s.

The author makes the aberration of the gravitating force the same as the aberration of light—assuming light and gravity to be transmitted in the same time—and as this will accelerate the orbital motion of a planet, it will counteract the opposite effect of the resistance of the ethereal medium. It is the same with the rotation of the sun, and of all rotating worlds. We do not enter into the calculations and theorems relating to the above and many other points, such as ethereal currents, &c., because we regard both the main points as yet unproved, and as resting on (improbable) assumption. "Nothing is more certainly established in physical astronomy than the excessive minuteness of the resistance offered by the ether to the planetary motions, if, indeed, there be such a resistance at all appreciable, even when the velocity is, as in the case of the earth, somewhere about 100,000 feet per second!" The evidence to the contrary once thought to have been given by the comet of Encke is not now relied upon. On the other hand the minute acceleration of the earth in its orbit (on the supposition of the transmission of gravity even with the speed of light) would increase the major axis, and therefore the length of the year very perceptibly in a short time. (See Note of Sir John Herschel in his "Familiar Lectures," &c., p. 90, and "Outlines," &c. (660), (661), 5th edition.) The author of the "Key to the Universe" calculates that this accelerating force would increase the periodic time of the sidereal year by 3 hours, 56 minutes, 17·2 seconds (p. 37), supposing the earth's orbit circular. It is curious that such a conclusion should not have made him suspect the soundness of his hypotheses, for a resisting medium powerful enough to counteract, upon the whole, such an effect, must inevitably have made itself known before now, not only (as once supposed) by Encke's comet, but in various other ways. The effects of the ethereal medium, and of the transmission of gravity are discussed in the 10th Book of the *Mécanique Céleste*, also in Mrs. Somerville's *Mechanism of the Heavens*, pp. 489-97, where it is shown that the former is insensible in regard to the moon and the earth; and that the latter must be more than fifty million times greater than the velocity of light, and may therefore be

regarded as instantaneous. Pontécoulant, *Théorie Analytique*, Vol. III., says one hundred millions. Like many others the author of this work makes more of the nebular theory than Laplace did. He thinks that its insufficiency to explain the phenomena of the universe has caused "the astronomical world to be again at sea without rudder or compass." He therefore presents a "compass of his own invention." We fancy astronomers attach at present comparatively little importance to *any* theory on this subject, although it has a certain interest of its own. The properties of the ether, it has been well observed, are of a much higher order in the arcana of nature than those of tangible matter, and the high priests of science still find the latter mostly far beyond their comprehension. Mr. Orson Pratt's book displays some ability and ingenuity, and we dare say cost him much trouble. We fear both have been misdirected.

The Solar Illumination of the Solar System, &c., &c. By Collyns Simon, Hon. LL.D., Edin. London: Williams and Norgate, 1879. pp. xliv. and 211.

The above is a small part of the title of this book—"wherein it is shown that according to undisputed facts of nature and of science, the solar illumination is equal throughout the whole system, and the law of the inverse squares for light, physically impossible. To which is added the prospectus for a prize of fifty guineas, offered for disproof of the scientific facts here for the first time indicated. Also an appendix from the writings of professional men." The writer has for five-and-twenty years been vainly endeavouring to call the attention of professional men to the "extraordinary errors" so long taught in the above laws. He takes, however, some comfort from the case of Dr. Young, who had to wait twenty years for the recognition of his great discovery. But, Dr. Simon, we fancy, is waiting rather like the rustic in Horace for the river to flow by that he may pass over. We think he has dilated on his crotchets in as wearisome a book as ever we met with.

Publications of the Cincinnati Observatory. Micrometrical measurements of 517 double stars, observed with the 11-inch refractor during the year 1877, under the superintendence of Ormond Stone, A.M., Director. Cincinnati, 1878. pp. ix. and 74.

The object-glass of this observatory has been refigured by Alvan Clark & Sons, and notwithstanding a large number of veins is now of excellent defining power. There are eight non-achromatic eye-pieces, magnifying from 95 to 1,500 times, and an achromatic and a diagonal eye-piece by Alvan Clark & Sons, magnifying 450 and 310 times respectively. The powers mostly employed in these measurements seem to have been 230 and 450. "Whether observing position angle or distance, care was always taken that the head of the observer should be so inclined that the line joining the two stars should be either normal or parallel to the horizontal section of the eyes." A careful investigation of personal equation was made; particulars of which are given in the introduction. The observers were Messrs. Herbert A. Howe, Winslow Upton, and Ormond Stone. "Colours were estimated numerically, 10 indicating red; 20, yellow; 30, blue; and intermediate numbers, intermediate colours. The amount of tinge was estimated on a scale of 5, zero indicating white. In recording these numbers the amount of tinge was written before the colour, with a period between the two, thus: 2.20 4.30 means that the principal star is somewhat tinged with yellow,

while the companion is deep blue." This is a very compendious way, but we are hardly sure we like it. The stars in this valuable work are chiefly southern; still many are accessible in this country. Publications like this, emanating from professional observers with first-class instruments, impress us with the conviction that double star work is passing away from the sphere of amateurs, unless exceptionally skilful and well-equipped. We copy particulars of one object, ν Scorpii, the principal star of which we believe was first found to be double by Mr. Burnham in 1863, who elongated A and B with 6-inch aperture and 400 power, and regarded the group as the finest known quadruple in the heavens. It has been seen double with the 26-inch Washington refractor, and with a 7½-inch by Dembowski. In the Cincinnati catalogue A and B are thus noted: Epoch 1877. 567. mag. 4.0 6.0. Angle of position 8°·6; dist. 0″·59; power used 630; and a note says, "occasionally notched." And for C and D, epoch 1877. 376. mag. 7·0 8.0. Angle of position 46°·2; dist. 1″.86; power 230. This pair is mentioned by Webb, (*Celestial objects*). We have seen it several times with 3¾-inch.

Observations of Mars at Madeira, August and September, 1877. By N. E. Green, Esq. (Reprinted from the *Monthly Notices* of the R. A. S., November, 1877, and the *Memoirs* of the R.A.S., Vol. XLIV.) pp. 26.

These observations were made with a reflecting telescope of the Newtonian form, with a 13-inch silver-on-glass speculum, figured by Mr. Geo. With, of Hereford, and kindly lent by him for the occasion. Its performance was perfect. The frame was mounted as an altazimuth, open at the sides, thus giving free access to the external air. The powers employed were from 200 to 400. The one most frequently used was 250. The instrument was first erected at an elevation of about 1,200 feet, and afterwards moved to a situation 2,200 feet above the sea. A very fine 12½-inch speculum, by Messrs. Horne and Thornthwaite was also employed. The twelve views which accompany this paper were selected from forty-one drawings, all of which were made direct from the telescope; the endeavour in the selection being to give a view of the planet at intervals of about two hours. They are compared with drawings made at Greenwich by Mr. Christie and Mr. Maunder, by Mr. Brett, at the Land's End, by Prof. Schiaparelli, at Milan, by Dr. Terby, at Louvain, Prof. Trouvelot, at Cambridge, U. S., Mr. Lockyer, Capt. Noble, Mr. Pratt, of Brighton, Mr. Banks, Dr. Dreyer, at Lord Rosse's observatory, Mr. Joynson, and others. The chart of Mars has also been compared with views of the planet by the above observers, and no form is introduced that has not been confirmed by the drawings of at least three observers. The names are those employed by Mr. Proctor in his chart of Mars, adapted as far as possible to the recent observations. New names have been added by the author where required.

The author observes that the drawings furnish evidences of the general clearness of the atmosphere of Mars, and though the presence of an atmospheric envelope is also abundantly shown, the clouds of Mars are evidently much less dense than those of the earth. Besides the evidence in favour of the white polar caps being composed of snow, there is also a strong indication of the presence of snow on the edge of Beer continent, near the equator, which may possibly be bounded by mountain ranges of great height. Similar lines of light, indicative of snow, may be seen in other portions of the surface of the planet. It has been remarked that the polar snow caps do not agree exactly with the poles of the axis of

rotation. An attempt has been made to illustrate the subject of colour in the drawings. "The general tone of the central portions of the disk may be described as a warm yellow, brightening into orange on some of the continents. . . . The darker portions, supposed to be water, were a greenish grey, partly due to contrast with the orange, but it varied so much in depth and tone, that much of its colour must have been the result of local changes. It was very interesting to observe the delicate alterations in depth of the darker portions, and if depth of tone means depth of water, deep indeed must be some parts of the sea of Kaiser."

The author expresses his thanks to those who kindly placed their drawings at his service, and to Mr. Marth for valuable information about the planet. Friends at Madeira rendered him much assistance, in particular Mr. Wm. Hipton and his family, and Mr. Charles R. Blandy. The views are accompanied by index maps, descriptions and observations, and a table of latitudes and longitudes has been supplied by Mr. Marth.

We are, indeed, highly indebted to Mr. Green for this reprint. At a a very favourable opposition of Mars, in 26 nights, of more or less goodness, under skies more propitious than our own, with an instrument of first-class excellence, he has carefully studied the features of the planet, which he well calls the "most terrestrial of the heavenly bodies." Aided by the kindred works of others, his skill and experience, both in observing and delineating, have enabled him to present us with a map and views finely executed, and which are really surprising when we reflect that under the best circumstances we are separated from Mars by 35 millions of miles. It will be remembered that the opposition of 1877 occurred only nine days after the planet had passed its perihelion, and the earth was at its greatest distance from the sun only two months previous. In some oppositions Mars is 62 millions of miles distant from us. If we take its distance at the opposition of 1877 at 35 millions of miles, this is equivalent to 146 times the mean distance of the moon from us. Yet the power of 250 used by Mr. Green, exhibited the planet as though it had a diameter of 2°, or nearly four times larger than the average full moon to the naked eye. In other words it showed Mars (nominally) as if seen at a distance of 140,000 miles without a telescope. It is, then, highly creditable both to opticians and astronomers that we should know so much of its surface. Strong as is its general resemblance to the earth, it is possible that a nearer acquaintance might bring out, as in the case of the moon, some puzzling and dissimilar features. At present, thanks to the united efforts of careful observers, there is, as remarked by Mr. Green, "an evident advance in the knowledge of fixed markings, and the doubts and difficulties which in former years have attended the effort to harmonise conflicting views, have in a great measure disappeared—a fairly consistent *Mars* being the product of the memorable opposition of 1877."

End-on Illumination in Private Spectroscopy, and its Applications to both 'Blow-pipe Flames and Electric Illumined Gas-Vacuum Tubes. By Piazzi Smyth, Astronomer-Royal for Scotland, &c. Read before the Royal Scottish Society of Arts, Feb. 10, 1879. Edinburgh: printed by Neill and Company. 1879. Pp. 20.

It occurred to Piazzi Smyth to look at the flame *end-on*, in place of, as almost every spectroscopist had hitherto done, *transversely* to the axis of the flame; the result, without any other change, was almost magical. The light was brought to the slit by an anterior image-forming object glass. The details given by the author show how admirably this contrivance answers.

METEOR.

Padre Denza writes in the Roman papers that a splendid meteor was seen on the evening of the 6th October, at 8h. 45m. It appeared in Lyræ, giving a light equal to that of the full moon on a clear night. Its nucleus seemed four times larger than Jupiter, and its light, at first bright green, passed into orange. It was followed by a luminous streak. After a rapid flight the bolide was extinguished in Corona Borealis. At the opening of the nucleus a noise was heard like the distant discharge of cannon.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

To all communications must be annexed the name and address of the sender, as a guarantee of good faith.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE GREAT SPOT IN JUPITER.

Sir,—On the 25th September, at 9.35 p.m., I had a good—and my first—view of the great spot in Jupiter, and my silvered mirror and achromatic eye-pieces exhibited it as reddish brown, or orange brown, certainly not red as it appears to have been seen by some observers using refracting instruments. It was then over the southern belt of the planet, about one-third of its diameter in length, surrounded by an elliptical band of light tint. It was moving to the left, and by 9.19 p.m. had disappeared without the dark part having reached the margin of the disc. Writing on the subject to M. Niesten, of the Brussels Observatory, I received from him an important letter, the principal parts of which I subjoin. Further observations of the spot confirmed my first estimate of its colour, whilst its modes of disappearance and reappearance indicated its position as considerably below the luminous surface of the planet.

Forest Row, Sussex:
Oct. 22, 1879.

I remain, &c., &c.,
HENRY J. SLACK.

M. Niesten says: Last year the red spot now seen on the disc had already attracted the attention of various observers. I doubt not it will be the same this year, for, from its characteristic form, and especially its permanence, it deserves to be studied. Since the 25th June I have frequently observed this fine spot. It always presented an elongated oval form. When in the middle

of the disc its greater axis parallel to the equatorial belts had a length of 13″ and its lesser axis of 3″. Micrometric measurements taken on different evenings showed that this spot described a parallel distant from the south pole about 15″, the polar diameter being 48″. That which most strikes the eye of the observer is the reddish brown colour by which it is uniformly tinted, and which is much more marked than that of the northern equatorial belt. This colour is heightened by contrast with the luminosity of the elliptical ring which surrounds it. This ring, the breadth of which is about 5″, is of a brilliant white, sharply standing out from the tint of the clear zone which immediately surmounts the dark belt south of the equator. Two round pearls show themselves in the upper limb of the ring, towards the western part of the red spot. These pearls were first seen on the 21st September, and I could again sketch them on the 24th and 29th of the same month. They were seen pretty easily by reason of their brilliant white hue. The ephemerides of Jupiter published by Mr. Marth in the *Astronomical Register*, permit us to ascribe to the centre of the red spot a zenographic* longitude of about 250°. In my observations I noted exactly the time when this spot reached the polar diameter of Jupiter, so as to furnish elements which will permit a determination of the times of its revolution. It may not be useless to add that the red spot is easily seen in a telescope of $0{\cdot}73^{mm.}$ aperture, that its western end appears first near the east margin of the planet, and that it advances gradually across the disc to disappear on the western side.

In my opinion spectroscopic and photographic observations would be very useful, for the determination of the physical constitution of this remarkable spot. In fact the photographs of Jupiter taken by Lord Lindsay in 1871, in the observatory of Mr. De La Rue, showed that the equatorial band which was reddish, always appeared transparent in the negatives, the light of the band not having acted in any way upon the sensitive plate (*Astronomical Register*, 1871, No. 97, p. 295). It would probably be the same with this red spot, for its colour is much more marked than that which usually tints the north equatorial belt.

I have been curious to see in the numerous sketches of Jupiter taken in former oppositions, if there were not traces of a spot or portion of a belt, similar to that now seen, and I have been able to prove that at different epochs a nearly identical spot has made its appearance in the same region on the disc of the planet. I will cite amongst others—

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* Ζῆν pro Ζεύς, Jupiter.

1858, 11 Oct., 13h. 15m., T.M.P. Goldschmidt drew and measured a remarkable black elongated spot (*Cosmos*, Vol. XIV., p. 148).

1858, 27 Oct., 16h. 30m., G.M.T. Mr. Murray noticed a remarkable streak visible below.

1858, 18 Nov., 15h. 45m., G.M.T. Mr. Lassell drew two remarkable oblong spots. In point of intensity they are not at all exaggerated in his drawing (*Monthly Notices*, Vol. XIX., p. 51).

1871, 1 Dec., 11h. 30m., G.M.T. A drawing of Mr. Gledhill shows a black spot in the south hemisphere, on the western side of the disc, while a beautiful oval luminous spot was seen to the east.

4 Dec., 10h. 40m., G.M.T. Black spot only seen occupying same place as on 1st December (*Astronomical Register*, 1870, April, p. 81).

1873. Lord Rosse's observations in *Monthly Notices*, Vol. XXXIV., p. 238 and seq., show:

7 March, 11h. 33m., G.M.T. Fig. 2, *a* and *b* very white, the following part of *b* reddish.

10 April, 9h. 12m., G.M.T. Fig. 3, *b* is very white with a reddish part on the following side.

22 March, 10h. 21m., G.M.T. Fig. 4. There is a reddish spot on the preceding side of *a* and *b*.

8 Feb. 13h. 30m., G.M.T. Fig 18. A reddish yellow patch on following side of *b*.

The drawings of M. Bredichin made in the Moscow Observatory show:

1875, 18 May, 11h. 40m., T.M.M. Fig. 14. The darkest spot on the disc is a band in the south temperate zone, cut by three clear stripes, to the right of which the darkness is a little more intense.

23 May, 10h. 40m., T.M.M. Fig. 18. The dark band of the zone *d* is cut obliquely by two clear stripes, the left one being very luminous, like a flux of the luminous matter across the dark band. In these observations the central meridian of the planet was approximately 249° and 246°.

1878, 23 May, 15h. 30m., T.S.M. Fig. 5. Central meridian 281°. The band *d* sends out protuberances into *c*, the interspaces between them being the darkest on the disc.

4 June, 15h. 40m., T.S.M. Fig. 8. M. C. 268°. Over *d* extends a brown ray crossed by brilliant stripes.

7 June, 15h. 30m., T.S.M. Fig. 12. M. C. 246°. The

clearest part is the lower branch of *d*. This branch is granular and white, and above it the darkest part is seen.

9 June, 15h. 45m., T.S.M. Fig 12. M. C. 29°. The zone *d* sends out three protuberances in the upper part of *c*. These protuberances are the brightest portion of the disc, and the interspaces are very dark.

After this come observations of this same red spot by Messrs. Pritchett, Niesten, Dennett, and Trouvelot, published in *Astronomical Register*, June, 1879, p. 143.

In 1869 Mr. Gledhill, in Mr. Crossley's observatory, was the first to notice a similar spot in the south hemisphere of Jupiter. It was seen in America by Mr. Mayer, and a second time by the first observer in 1873 (*Astronomical Register*, 1870, August, No. 92, p. 169). In the drawings of Jupiter published in the observations of Bothcamp (?) the 13 May, 17h. 8m., 1871, Mr. Lohse figures an elliptical cloud, bright white. in the same region of Jupiter, and M. Bredichin, at Moscow, noticed an oval luminous spot on the 25 April 1875, at 11h. 45m.. T.M.M., and on 10 July, 1877, 17h. 45m., T.S.M.

It would be interesting to study the question of whether these oval spots, dark or light, present themselves in different oppositions in nearly the same meridian. Concerning the red spot, the observations of Lord Rosse in 1873, those of Bredichin in 1876, and those of 1878 and 1879 appear to affirm it.

The careful work of Mr. Marth, indicating the central meridian in different drawings of Mars, and which have so powerfully aided a knowledge of the topography of that planet, has to be done with the numerous drawings of Jupiter.

M. Niesten inquires whether Mr. Marth can give information on this subject earlier than December, 1871, when his ephemerides of Jupiter were first published in the *Astronomical Register*. In a note to Capt. Noble Mr. Marth says he is not aware of any ephemerides of Jupiter being published before December, 1871.

M. Niesten inquires if anything is known of an association for studying Jupiter? Perhaps some of your readers can tell.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN NOVEMBER, 1879.

By W. R. Birt, F.R.A.S., P.S.S.

The publication of observations will always contribute to the advancement of our knowledge. It is well known to selenographers that the lucid streaks on the moon offer a very difficult problem for solution, and but little is known of them at the present time. The study may be divided into descriptive, confirmative, and discussive. Each set of observations belongs to the descriptive, and from the raw material from which

deductions are drawn. So far as the writer is aware, most observers content themselves with making observations, and if they obtain a suitable channel proceed to publish them, but in many cases they stop short of the most important step, discussing them, perhaps for want of knowing how to discuss them, especially if many observations have accumulated. In the case of the streaks near Proclus, Mr. Dennett has embodied the results of his observations in a diagram published in the *English Mechanic*, No. 754, Sept. 5, 1879, p. 648, col. 3, but in a great measure his observations stand alone, for only in a very partial degree have they been confirmed. In order to effect this each observer should, as soon after his observations have been made as convenient, ascertain if his observations *confirm* or *disagree* with those already on record; contemporaneously with this process he should draft (ledgerise) each observation into a *table* drawn out to tenths of days of the moon's age, which although not giving exact results will still be sufficiently exact to bring out *variability* if it exists. By many this will be considered a tedious process, but if persevered in for several lunations will yield important and interesting results. As examples and illustrations we shall give some recent observations of Mr. J. P. Gray, of Bedford.

It will be remembered that since the publication of Mr. Dennett's diagram, above alluded to, some attention has been directed to the crater Peirce A and one of Mr. Dennett's streaks marked VIII. Mr. Dennett gives two streaks that cross each other, a little south-east of Peirce A, marked respectively VIII. and VIII'. One of these streaks, as observed by Mr. Dennett, has not been confirmed, neither has the *crossing* of the two been continued. On September 25, at 11 p.m., moon's age 9·7 days, D. J. P. 2407618, Mr. Gray noticed a white spot where Peirce A should have been visible, so far confirming Mr. Dennett's general statement that when the sun rises high upon Peirce A, it becomes, or rather appears, as a bright spot. Mr. Gray observed that it was surrounded by a dark aureole with an only partially complete ring. He further says at 11·30, "I again thought I could catch sight of Peirce A, though only by glimpses."

Mr. Gray obtained another observation on Oct. 1st, from 10 to 11 p.m. Moon's age 15·7 days, D. J. P. 2407624. In his record he says, "running from Peirce A and in such a direction that if it were produced it would pass just south of Proclus was a brilliant, thin [narrow] white line [streak], showing clearly against the softer and more diffused ray which formed its background and which filled up the space between Peirce and Peirce A. [This appears to be Dennett's VIII. emanating from a point on or near the north-west wall of Proclus, and which he somewhere characterises as a *bright point*. On October 1st this particular streak was not traced from Peirce A by Mr. Gray beyond the border of the Mare Crisium, so that on this occasion it was confined to the surface of the Mare upon which it appeared as quite straight, extending from the border of the Mare Crisium to the southern wall of Peirce A. It will be remembered that the intersection that Mr. Dennett speaks of is S.E. of Peirce A, and this difference is in accordance with the motion that has been attributed to the northern streak. Again, the space between Peirce and Peirce A being occupied by the softer diffused streak, probably indicates a widening of Schröter's northern streaks. Mr. Gray remarks that the observation of October 1 corresponds with that of August 4, 1879, at 13·30, in which a thin streak of light extended from the eastern border of the Mare Crisium to the southern edge of Peirce A; not the slightest bend in it was observable. The smallest period of similar phase, 59 days 1 hour 28 mins., would give October 2nd, 14h. 58m. for the

repetition of the phenomenon seen on August 4, and the character of the thin streak being identical on both occasions, there can be but little doubt that the streak seen by Mr. Gray on August 4 was permanent between August 4 and October 2 in the present year. The next apparition will occur about November 30. Day of Julian Period November 7, 2407661, November 17, 2407671, November 27, 2407681.

Water Lane, Stratford, E.:
October 20, 1879.

Errata in last list page 243, line 6, for *workings* read *markings;* line 13, for *observation* read *obscuration.*

THE PLANETS FOR NOVEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury ...	1st	15 27 3	S. 20 33½	5″·0	0 45·3
	9th	16 14 42	S. 23 36	5″·4	1 1·4
	17th	16 59 48	S. 25 20	6″·2	1 14·9
	25th	17 34 34	S. 25 31	7″·2	1 18·1
Venus ...	1st	11 51 47	S. 0 22	37″·6	21 6·7
	9th	12 13 13	S. 1 21½	33″·4	20 56·7
	17th	12 38 23	S. 3 0½	29″·8	20 50·3
	25th	13 6 16	S. 5 8	27″·0	20 46·6
Mars ...	1st	3 26 49	N. 18 20½	23″·0	12 43·1
	9th	3 14 50	N. 18 2½	22″·9	11 59·7
	17th	3 2 50	N. 17 41	22″·3	11 16·3
	25th	2 52 31	N. 17 21	21″·3	10 34·6
Jupiter ...	1st	22 21 12	S. 11 40½	41″·2	7 34·3
	9th	22 21 55	S. 11 32	40″·2	7 7·6
	17th	22 23 27	S. 11 24½	39″·2	6 37·7
	25th	22 25 46	S. 11 9½	38″·2	6 8·5
Saturn ...	1st	0 42 17	N. 1 36½	17″·6	9 59·1
	9th	0 40 31	N. 1 26½	17″·4	9 25·9
	17th	0 39 4	N. 1 19	17″·2	8 52·9
	25th	0 37 59	N. 1 14	17″·0	8 20·4
Neptune ...	1st	3 35 26	N. 13 17½	...	11 51·9
	17th	2 33 42	N. 13 9	...	10 47·2

Mercury sets about twenty-five minutes after the sun at the beginning of the month, the interval increasing.

Venus rises about three hours and a half before the sun on the 1st, the interval increasing.

Mars rises about a quarter of an hour before sunset on the 1st. On the 9th he rises at sunset, after which day he rises before sunset, the interval increasing.

Jupiter sets about midnight at the beginning of the month, and then earlier each night. He is at quadrature with the sun on the 26th.

Saturn sets about four hours after midnight on the 1st, the interval decreasing.

ASTRONOMICAL OCCURRENCES FOR NOVEMBER, 1879.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage
		h. m.			h. m. s.	h. m.
Sat	1		Sidereal Time at Mean Noon 14h. 41m. 36·56s.	1st Tr. E.	4 52	Jupiter.
				1st Sh. E.	6 6	—
				2nd Tr. I.	8 32	
				2nd Sh. I.	11 1	7 38·3
				2nd Tr. E.	11 24	
Sun	2	8 24	Near approach of 118 Tauri (6)			
		22	Neptune at opposition to the Sun	4th Tr. I.	8 30	7 34·5
Mon	3		Sun's Meridian Passage 16m. 19·60s. before Mean Noon	2nd Ec. R.	8 0 26	7 30·6
Tues	4	11 1	Occultation of δ Geminorum (3$\frac{1}{2}$)			
		11 37	Reappearance of ditto			7 26·7
		15 11	Occultation of 63 Geminorum (5$\frac{1}{2}$)			
		16 32	Reappearance of ditto			
Wed	5					7 22·9
Thur	6	17 55	☾ Moon's Last Quarter	1st Tr. I.	9 57	
				1st Sh. I.	11 14	7 19·0
				1st Tr. E.	12 17	
Fri	7	14 24	Occultation of B.A.C. 3398 (6)			
		15 5	Reappearance of ditto	3rd Oc. D.	4 45	
		15 41	Occultation of B.A.C. 3407 (6)	1st Oc. D.	7 17	
				3rd Oc. R.	8 20	7 15·2
		16 40	Reappearance of ditto	3rd Ec. D.	10 6 52	
		17	Occultation of π Leonis (5)	1st Ec. R.	10 50 59	
		18 6	Reappearance of ditto			
Sat	8	13 38	Occultation reappearance of 34 Sextantis (6)	1st Tr. I.	4 25	
				1st Sh. I.	5 43	
				1st Tr. E.	6 45	7 11·4
				1st Sh. E.	8 20	
				2nd Tr. I.	11 3	
Sun	9			1st Ec R.	5 19 56	7 7·6
Mon	10	17 8	Occultation of q Virginis (6)			
		17 37	Reappearance of ditto	2nd Oc. D.	5 12	
		13	Conjunction of Moon and Venus 5° 36′ N.	2nd Ec. R.	10 37 16	7 3·8
Tues	11			4th Ec. R.	7 38 50	7 0·0
Wed	12	8	Mars at opposition to the Sun	2nd Sh. E.	5 48	Mars. 11 43·3
Thur	13	12 38	● New Moon	1st Tr. I.	11 50	11 37·9
Fri	14			3rd Oc. D.	8 38	11 32·4
				1st Oc. D.	9 11	
Sat	15	0	Conjunction of Moon and Mercury 0° 13′ N.	1st Tr. I.	6 19	
			Illuminated portion of disc of Venus=0·388	1st Sh. I.	7 39	11 27·0
				1st Tr. E.	8 38	
			Illuminated portion of disc of Mars=1·000	1st Sh. E.	9 58	
Sun	16		Saturn's Ring: Major axis=43″·21 Minor axis= 5″·74	1st Ec. R.	7 15 38	11 21·6

DATE.		Principal Occurrences.	Jupiter's Satellites.		Meridian Passage.
		h. m.		h. m. s.	h. m.
Mon	17	Sidereal Time at Mean Noon 15h. 44m. 41·45s	1st Sh. E.	4 26	Mars.
			2nd Oc. D.	7 45	11 16·3
		6 36 Occultaiion of σ Capricorni (5½)	3rd Sh. I.	4 9	
Tues	18	7 40 Reappearance of ditto	3rd Sh. E.	7 37	11 10·9
		Sun's Meridian Passage 14m. 29·73s. before Mean Noon	2nd Sh. I.	5 36	
			2nd Tr. E.	5 47	
Wed	19		4th Tr. E.	6 20	11 5·6
			2nd Sh. E.	8 26	
		6 55 ☽ Moon's First Quarter			
		0 Conjunction of Jupiter and σ Aquarii 0° 2′ N.			
Thur	20	21 Conjunction of Moon and Jupiter 5° 30′ S.			11 0·3
Fri	21		1st Oc. D.	11 5	10 55·1
		7 55 Occultation of 16 Piscium (6)	1st Tr. I.	8 13	
Sat	22		1st Sh. I.	9 34	10 49·9
		9 6 Reappearance of ditto	1st Tr. E.	10 33	
		10 57 Occultation of 45 Piscium (6)			
		11 57 Reappearance of ditto	1st Oc. D.	5 34	
Sun	23	21 Conjunction of Moon and Saturn 8° 26′ S.	1st Ec. R.	9 11 19	10 44·7
			1st Sh. I.	4 3	
		4 Conjunction of Venus and θ Virginis 0° 2′ N.	1st Tr. E.	5 1	
Mon	24		1st Sh. E.	6 22	10 39·6
			2nd Oc. D.	10 20	
			3rd Tr. E.	6 15	
Tues	25		3rd Sh. I.	8 11	10 34·6
		7 Jupiter at quadrature with the Sun			
		18 Conjunction of Moon and Mars 3° 51′ S.			
		8 45 Near approach of B.A.C. 782 (6½)	2nd Tr. I.	5 30	
		8 24 Occultation of μ Arietis (5½)	2nd Sh. I.	8 13	
Wed	26		2nd Tr. E.	8 23	10 29·6
		9 42 Reappearance of ditto	2nd Sh. E.	11 4	
		18 8 Near approach of 47 Arietis (6)			
		18 45 Near approach of ε Arietis (4½)			
		6 50 Near approach of 66 Arietis (6½)			
		11 34 Occultation of 9 Tauri (6)	4th Oc. D.	9 4	10 24·6
		12 43 Reappearance of ditto			
		8 57 ○ Full Moon			
Fri	28	8 18 Occultation of 62 Tauri (6)	2nd Ec. R.	5 10 13	10 19·6
		9 22 Reappearance of ditto			
		16 6 Occultation of 118 Tauri (6)	1st Tr. I.	10 9	10 14·7
Sat	29	16 32 Reappearance of ditto			
		9 16 Occultation of 5 Geminorum (6)			
		10 19 Reappearance of ditto	1st Oc. D.	7 30	10 9·9
Sun	30	23 Uranus at quadrature with the Sun			
			1st Tr. I.	4 38	
DE	C.	10 30 Occultation of 44 Geminorum (6½)	1st Sh. I.	5 59	10 5·1
Mon	1	10 38 Reappearance of ditto	1st Tr. E.	6 57	
			1st Sh. E.	8 17	

THE SATELLITES OF MARS, 1879.

Angle of position p_o of the major axes of the apparent ellipses described by the satellites, and major and minor semi-axes a b expressed in semi-diameters of the planet's disk, and also in seconds of arc, a'' b''.

		Phobos.				Deimos.			
oh. Gr.	p_o	a	b	a''	b''	a	b	a''	b''
	°			″	″			″	″
Nov. 0	53·35	2·77	0·59	26·72	5·68	6·94	1·48	66·86	14·22
10	52·91		0·68	26·64	6·50		1·69	66·66	16·25
20	52·60		0·76	25·59	7·00		1·90	64·04	17·52
30	52·46	2·77	0·82	23·80	7·06	6·94	2·06	59·56	17·66

Deimos will be at its greatest elongations ("nf." in position angle 53° and "sp." in pos. 233°) about the following times:

G.M.T.	h.			h.			h.			h.	
Nov. 1	2·1	sp.	Nov. 9	6·9	nf.	Nov. 17	11·6	sp.	Nov. 25	1·2	sp.
	17·3	nf.		22·0	sp.	18	2·7	nf.		16·3	nf.
2	8·4	sp.	10	13·1	nf.		17·8	sp.	26	7·5	sp.
	23·5	nf.	11	4·3	sp.	19	9·0	nf.		22·6	nf.
3	14·7	sp.		19·4	nf.	20	0·1	sp.	27	13·7	sp.
4	5·8	nf.	12	10·5	sp.		15·3	nf.	28	4·9	nf.
	20·9	sp.	13	1·7	nf.	21	6·4	sp.		20·0	sp.
5	12·1	nf.		16·8	sp.		21·5	nf.	29	10·2	nf.
6	3·2	sp.	14	7·9	nf.	22	12·7	sp.	30	2·3	sp.
	18·3	nf.		23·1	sp.	23	3·8	nf.		17·4	nf.
7	9·5	sp.	15	14·2	nf.		18·9	sp.	Dec. 1	8·5	sp.
8	0·6	nf.	16	5·3	sp.	24	10·1	nf.		23·7	nf.
	15·7	sp.		20·5	nf.				2	14·9	sp.

About 3·8 hours before and after the times of greatest elongations Deimos will be at the distance of one diameter of the disk from the edge of the disk, and about 3·9 hours before and after the greatest elongations at the distance of two diameters. Some position angles of Deimos, observed on Oct. 15 by Mr. Common, indicate that the times of the greatest elongations given on page 249 for October are about 0·3h. too early. Observations of Phobos have not yet become known. A. M.

MARS.

Mädler's spot "a" will pass the central meridian of the planet's disk about the following times:

1879.	h.		h.		h.
Nov. 24	4·2	Nov. 27	6·1	Nov. 30	7·9
25	4·8	28	6·7	Dec. 1	8·6
26	5·5	29	7·3	2	9·2

V. page 249. A. M.

THE INNER SATELLITES OF SATURN.

Major and minor semi-axes of the apparent orbits of the satellites, expressed in semi-diameters of Saturn's equator.

		Mimas.	Encel.	Tethys.	Dione.	Rhea.
Major		3·14	4·03	4·99	6·40	8·93
Minor	Nov. 1	0·43	0·56	0·69	0·88	1·23
	" 11	0·42	0·54	0·67	0·86	1·20
	" 21	0·41	0·53	0·66	0·84	1·17
	Dec. 1	0·41	0·52	0·65	0·83	1·16

Approximate Greenwich times of some of the conjunctions of the satellites with the centre of the ball and the ends of the ring, v. p. 216:

1879.	Gr. M. Time. h.		
Nov. 1	7·7	Dione	np.
	8·7	Rhea	sup. s.
2	8·8	Encel	nf.
	12·6	Dione	sf.
	14·2	Tethys	nf.
3	7·8	Encel	sf.
	12·8	Tethys	sp.
	13·5	Dione	nf.
	14·9	Rhea	inf. n.
4	10·1	Encel	sp.
	11·4	Tethys	nf.
5	6·2	Dione	sf.
	9·1	Encel	np.
	10·1	Tethys	sp.
6	7·1	Dione	nf.
	8·7	Tethys	nf.
	11·4	Encel	nf.
7	7·4	Tethys	sp.
	10·4	Encel	sf.
	14·5	Tethys	sf.
8	6·0	Tethys	nf.
	12·7	Encel	sp.
	13·2	Tethys	np.
9	8·7	Dione	np.
	11·7	Encel	np.
	11·8	Tethys	sf.
10	9·4	Rhea	sup. s.
	9·6	Dione	sp.
	10·5	Tethys	np.
11	6·5	Encel	sp.
	9·1	Tethys	sf.
	13·1	Encel	sf.
12	7·8	Tethys	np.
13	6·4	Tethys	sf.
	7·8	Encel	nf.
	11·2	Dione	sf.
14	6·8	Encel	sf.
	12·1	Dione	nf.
15	9·1	Encel	sp.
16	8·2	Encel	np.
17	5·8	Dione	nf.
	10·5	Encel	nf.
	13·7	Dione	np.
18	9·5	Encel	sf.
19	10·1	Rhea	sup. s.
	11·8	Encel	sp.
20	7·4	Dione	np.
	10·8	Encel	np.
	12·5	Tethys	sp.
21	8·2	Dione	sp.
	11·1	Tethys	nf.
22	5·6	Encel	sp.
	9·8	Tethys	sp.
23	8·4	Tethys	nf.
24	6·9	Encel	nf.
	7·1	Tethys	sp.
	9·9	Dione	sf.
25	5·7	Tethys	nf.
	5·9	Encel	sf.
	10·8	Dione	nf.
	12·9	Tethys	np.
26	4·7	Rhea	inf. n.
	8·2	Encel	sp.
	11·5	Tethys	sf.
27	7·2	Encel	np.
	10·2	Tethys	np.
28	4·5	Dione	nf.
	8·8	Tethys	sf.
	9·5	Encel	nf.
	10·9	Rhea	sup. s.
	12·4	Dione	np.
29	7·5	Tethys	np.
	8·5	Encel	sf.
30	6·1	Tethys	sf.
	10·9	Encel	sp.
Dec. 1	4·8	Tethys	np.
	6·1	Dione	np.
	9·6	Encel	np.

A. M.

JUPITER.

1879.	Angle of position of 4's axis.	Latitude of Earth above 4's equator.	Latitude of Sun above 4's equator.	Equat. diameter.	Greatest phase.
Nov. 6	336·63	+1·17	+1·47	42″·86	0″·38
16	336·56	1·16	1·51	41·48	0·40
26	336·43	+1·15	+1·55	40·15	0·40

The assumed First Meridian passes the middle of the illuminated disk at the following times:

1879.	G. M. T. h. m.
Nov. 1	5 23·7
2	1 14·7
	11 10·2
3	7 1·3
4	2 52·3
	12 47·8
5	8 38·9
6	4 29·9
7	0 21·0
	10 16·5
8	6 7·6
9	1 58·6
	11 54·1
10	7 45·2

	h. m.
Nov. 11	3 33·6
	13 31·8
12	9 22·9
13	5 14·0
14	1 5·1
	11 0·6
15	6 51·7
16	2 42·8
	12 38·3
17	8 29·4
18	4 20·5
19	0 11·6
	10 7·2
20	5 58·3

	h. m.
Nov. 21	1 49·4
	11 45·0
22	7 36·1
23	3 27·2
	13 23·8
24	9 13·9
25	5 5·1
26	0 56·2
	10 51·8
27	6 42·9
28	2 34·0
	12 29·6
29	8 20·8
30	4 11·9
Dec. 1	0 3·1
	9 58·6

About 3h. 20m. *before* these terms the reddish spot now visible on Jupiter's southern hemisphere will *begin* to cross the middle of the illuminated disk, and will take more than an hour in passing it. It is very desirable that careful estimations should be, whenever possible, for ascertaining the exact times when the preceding and following ends, and also the middle of the spot, apparently cross the axis of Jupiter. A. M.

Books received.—First Part of Vol. XI. of the Annals of the Harvard College Observatory,—Proceedings of the American Academy. By Professor Langley.—Observations upon the Temperature, &c., of the Past Summer. By C. L. Prince.—A Handbook of Double Stars. By Edw. Crossley, Joseph Gledhill and James Wilson. London: Macmillan & Co. 1879.—Double Star Observations. By S. W. Burnham.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Oct., 1879.	To Dec., 1879.	To Jan. 1880.
Fisher, J. S.	Lettsom, W. G.	Cooper, W. E.
Harker, J. C.		

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The Astronomical Register.

No. 204. DECEMBER. 1879.

ROYAL ASTRONOMICAL SOCIETY.

Session 1879—80.

The First Meeting after the Long Vacation, November 14th, 1879.

Lord Lindsay, M.P., *President*, in the Chair.

Secretaries—Mr. Glaisher and Mr. Ranyard.

The minutes of the preceding meeting were read and confirmed.

William Charles Armstrong, Esq., Wanderers' Club, Pall Mall.

Prof. J. J. Astrand, Observatory, Bergen, Norway.

Thomas W. Bithrey, Esq., 45, Stepney Green, London, E.

Rev. James Law Challis, M.A., Vicarage, Stone, near Aylesbury, Bucks.

George Howard Darwin, Esq., M.A., Trinity College, Cambridge.

Henry T. Vivian, Esq., 34, Wellington Road, Camberwell, S.E.

Robert Rumsey Webb, Esq., M.A., St. John's College, Cambridge,

were balloted for and duly elected Fellows of the Society.

Mr. Glaisher announced that 169 presents had been received since the last meeting, amongst which he drew especial attention to "A Handbook of Double Stars," by Mr. Edward Crossley and Mr. Gledhill and Mr. Wilson, and to a quarto book on Auroræ, by Mr. Rand Capron. Dr. H. Draper had presented to the Society some original negatives of the spectrum of oxygen compared with the solar spectrum, and Dr. Gould, of Cordova, had presented some large photographs of the moon, which were exhibited in the meeting room. The thanks of the Society were voted to the donors.

Professor Adams was called upon to read a paper *On the ellipticity of Mars, and its effect on the motion of the satellites.* He said that one of the results of Professor Asaph Hall's discussion of the observation of the satellites of Mars was to show that the orbits of both the satellites are at present inclined at small angles to the plane of the planet's equator. It becomes an interesting question to inquire whether this state of things is a permanent one. If the planes of the orbits of the satellites retain constant inclinations to the orbit of the planet, as they would do if the sun's disturbing force were the only one acting, their inclinations to the plane of the equator of Mars (which makes an angle of 27° or 28° with the plane of the orbit) would in time become considerable. In a recent number of the *Astronomische Nachrichten*, Mr. Marth has found the motions of the nodes of the orbits of the satellites on the orbit of the planet due to the disturbing action of the sun, and he concludes that if there is no force depending on the internal structure of Mars, which modifies the sun's action, the nodes of the orbits will be in opposition to each other a thousand years hence. But it is well known that if there is no disturbing force the ellipticity of a planet would cause the nodes of its satellite's orbit to retrograde on the plane of the planet's equator. The ellipticity of Mars is still unknown, and is probably too small to be ever directly measured, but its amount may probably be determined from the motion of the satellites.

Taking various values of the ellipticity of Mars, and assuming that the internal density of the planet varies as in the earth, Professor Adams calculated the annual motion of the nodes of the satellites due to the assumed ellipticity and the corresponding inclinations to the fixed plane to the planet's equator, and inferred that the ellipticity of the planet was sufficiently great to cause the orbit of the first satellite to preserve a constant inclination to a plane which is inclined less than 1′ to the plane of the equator of Mars, and that the orbit of the second satellite preserves a constant inclination to a plane which is inclined about 1° to the plane of the equator.

The ellipticity will also cause rapid motions in the apsides of the orbits of the satellites, particularly in that of the inner satellite, and as this orbit appears, from Professor Hall's observations, to have a sensible eccentricity, it will be possible, by future observations, to determine the motion of the apse, and, consequently, the ellipticity of the planet.

Mr. Marth said: The inclination of the equator of Mars to its orbit has, till lately, been assumed to be 27° to 28°, but the observations made in 1877 by Asaph Hall and Schiaparelli tend to show that a considerable correction is required. From the obser-

vation of one opposition alone it is not feasible to determine more than the direction of the pole of the planet's equator; to find the pole itself, observations are also wanted, when the place of Mars has considerably shifted. If one makes allowance for this, I think one can only deduce that the equator of Mars is really almost coinciding with the planes of the satellites' orbits. One difficulty about this is that Hall and Schiaparelli disagree considerably, and it is to be hoped that the discrepancy may be cleared up, and that careful observations are being made that will determine the position of the axis. As regards the effect of the planet's ellipticity it will perhaps be possible that if observations can be made in 1881, the motion of the nodes may already be perceptible, but if this year's observations are not more abundant than at present there is any sign of, I am afraid they will not be sufficient to fix the node, and we shall have to wait till 1890, when the opposition occurs at the end of May, not favourable for northern astronomers. But the observations of 1892 or 1894 may be looked for to decide the question to a degree unhoped for. I may mention with regard to my neighbour Mr. Common, that up to this time he is the only observer in Europe who has seen both satellites. His observations show that Deimos is behind its predicted place about 4°, while Phobos is in advance about 50°, and the computed time of the revolution of Phobos must be shortened by a second and a half. I can only hope Mr. Common may be successful in following both satellites as long as possible. Unfortunately, in order to fix the node with any degree of certainty, it is necessary to get observations very close to the planet, and I am afraid the observations do not go near enough to give the node with certainty. There is no doubt that these satellites are a great treat from more than one point of view, and that in time they will enable astronomers to determine the ellipticity of the planet with an accuracy which was scarcely to be hoped for.

The thanks of the Society were voted to Professor Adams for his paper.

Mr. Ranyard said: The Society will, I am sure, be glad to welcome Mr. Stone again. He has a paper *On the evidence of a part connection between four widely separated southern stars.* (Applause.)

Mr. Stone said that in the formation of the Cape Catalogue he had examined the evidence with respect to the large proper motions which had been assigned to some of the southern stars. In the greater number of cases these large proper motions have not been confirmed, but in the case of ζ Toucani, ϵ Eridani, ζ^1 Reticuli, and ζ^2 Reticuli, the proper motions appear to have been fairly well determined, and thay seemed to indicate the existence in the past of a close connection between these stars. Though now so widely

separated, these four stars have proper motions much larger than the average proper motion of stars, viz., 2·13″, 2·99″, 1·47″ and 1·45″ respectively. They have also a common proper motion amounting to more than 1″ of arc, and it seems that each star of the group is moving away from every other star of the group at a rate which is small compared with the common proper motion of the group, and roughly speaking, the velocities of separation are larger the larger the present angular separation of the stars. It is clear that in the remote past the stars may have formed a group much closer together than at present, and, possibly, between 300,000 and 400,000 years ago the system may have had its origin in a system of two double stars, like α_1 and α_2 Centauri, with a large common proper motion, which were brought sufficiently near together to change the systems from close to open orbits.

Mr. Stone also read a paper *On a comparison between the right ascensions and north polar distances of the Nautical Almanac and the general Cape Catalogue for* 1880, and referred to a difference in the corrections for refraction which he had found it necessary to make for the summer and winter months.

Mr. Waters: There is in the first paper a very interesting example of the common proper motions of a group of stars. Would Mr. Stone say whether the stars which appear to move with a common motion are of similar magnitude, or whether they differ greatly?

Mr. Stone: They are very nearly of the same magnitude. They are all about the fourth or fifth magnitude.

Mr. Dunkin: What is the difference in right ascension between the stars?

Mr. Stone: I can give you more than that. I can give you the angular distance of the stars. The first two are only about 5′. These two are 19° apart.

Mr. Dunkin: That seems a great distance for stars to be physically connected together.

Mr. Stone: Yes; but the relative proper motion would bring them together in less than 400,000 years, which geologists would consider an admissible period (laughter).

Mr. Ranyard: Is the relative proper motion sufficiently large to enable you to say whether the direction of the relative proper motions meet in a point?

Mr. Stone: No, there is some difficulty about that. All I can say is that the stars are moving in directions that are carrying them away from one another.

Mr. Christie was called upon to read a paper by Mr. J. C. Draper *On a photograph of the solar spectrum showing dark lines of oxygen.* He said: Professor J. C. Draper has asked me to

exhibit a photograph of the solar spectrum showing certain fine absorption lines which he thinks are coincident with the lines of the spectrum of oxygen, and that they appear darker in the sun than the ordinary absorption lines. The apparatus used was a heliostat and a silvered-glass mirror, and a slit and prism with a camera box. The light passes from the prism to the collodion plate with nothing intervening except a glass with a scale, and to this point he attaches a great deal of importance. He mentions that the spectrum and the slit were very narrow. On the photograph there is a cross and a scale, and to the right hand there are certain vacant spaces. In these spaces on the red side of the G line, Professor Draper calls attention to certain fine lines, which he considers to be the representatives of the spectrum of oxygen. It appears that various observers have found bright lines in the spectrum of the spark in oxygen which agree approximately in position with these spaces, and Professor Draper's view is that the spectrum of oxygen in the sun splits up into these fine lines across the bright spaces. This is a pure inference, of course. At the same time I think you will find his photograph is a very fine one of the solar spectrum. It contains a number of fine lines, and whatever may be thought of his inferences it will have great value from the beauty of its definition.

Mr. Ranyard: I conclude that I am right in assuming that there is no new fact with regard to the spectrum of oxygen, and that this is merely a theory of Mr. J. C. Draper's. He assumes that under certain conditions, not yet the subject of experiment, the oxygen lines may break up into a number of bright lines opposite to the narrow dark lines which happen to be upon the bright spaces, to which Dr. Henry Draper has called attention. In fact, there is no new experiment here with regard to the oxygen spectrum.

Mr. Christie: This is an experiment with regard to the solar spectrum pure and simple. There is no comparison with the oxygen spectrum. But there is another point I omitted to mention, and that is that Professor J. C. Draper calls attention to the fact that these spaces between the dark lines in the sun are actually less bright than the other spaces on the more refrangible side of G. From that he infers that there is absorption and, as there are oxygen lines there, the absorption must be due to oxygen. I have nothing to do with the argument in this case. I merely put the photograph before the Society as Professor Draper has given it to me, and I do not express any opinion in the matter.

The President: I have seen the photograph. It is really a beautiful object.

Mr. De La Rue was then called upon, he said: I was recently

in Hamburg, and I there saw the mounting of a telescope that is being made for Dr. Winnecke, of Strasburg, at Messrs. Repsold's manufactory. It is a remarkable piece of mechanical engineering, and I think will prove extremely rigid and at the same time very mobile. I do not wish to pass any eulogium on this mounting, but merely to call attention to the conical pendulum which Messrs. Repsold were so good as to describe to me, and which I think will go very far in the direction of solving a very important problem—a conical pendulum which will give a true and continuous motion without any very great variation of rate. It consists of a steel rod and ball. The rod is clipped quite tight at the top. When motion is given to the pendulum the pendulum will move conically, and will gradually move away from the centre, bending the rod, and thus the force which tends to bring the pendulum to the vertical is not so much the force of gravity as the elasticity of the rod. In fact, it is a conical pendulum very much on the principle of the balance wheel and spring of a watch. Messrs. Repsold did not show me any experiments because I had not time to see them, but they assured me that when the driving weight of the clock was increased 15 times, the variation of the rotation was only 0·4 per cent., and it really appears to me that this is the most valuable invention we have had with regard to the solution of this very important problem.

The President asked if this was a seconds pendulum giving two seconds rotation?

Mr. De La Rue: That would depend entirely on the gearing of the clock. It was to drive the equatorial. I cannot tell you exactly. I think the pendulum was intended to be two feet long.

Mr. : If the action of the pendulum is not at all due to gravity, the length has nothing to do with its rotation.

Mr. De La Rue: I wished to state that the main force involved in bringing it to the vertical was the elasticity of the rod. I did not go into all the particulars, as, of course, an account will be given of the instrument, but I thought it would be agreeable to the Society to have an early intimation of it. (Hear, hear.)

Mr. Neison: I would like to ask, did Messrs. Repsold say that there were no changes of rate due to temperature?

Mr. De La Rue: The only experiment Messrs. Repsold brought under my notice was the question of the differences of weight. It is not intended in any way to be a pendulum which is to go from year to year *at the same rate*, because that is easily adjustable at the time of observation, but if you get a pendulum which is driving a telescope an hour or two hours at a perfectly uniform rate, we shall have accomplished what has never been accomplished before—a *perfectly* uniform rate.

The President: I think your clock nearly does it, and I am sure mine does. (Laughter.)

The thanks of the meeting were returned to Mr. De La Rue.

Mr. Maxwell Hall read a paper *On the nebulæ in the Pleiades.* He had made frequent observations of the nebula with a small 4-inch telescope, when in Jamaica, and found that it was as well seen with a small instrument as with a larger. His paper contained references to earlier observations of the nebula and was accompanied by a map.

Dr. Schuster read a paper *On the polarization of the corona.* From a theoretical investigation of the polarization of the light dispersed by small particles distributed uniformly about a luminous sphere, it appeared that the polarization of the corona ought to decrease in passing outwards from the sun's limb. This was also shown to be the case when the distribution of the luminous particles was not uniform, but decreased in proportion to the distance from the sun's limb. Dr. Schuster was of opinion that the polarimeter measures which had been made of the polarization of the corona at various altitudes above the sun's limb would enable us to determine the law of distribution of the particles in the corona at various altitudes above the sun.

Mr. Ranyard said: I have not had an opportunity of studying Dr. Schuster's paper, but it looks as if he had made several new steps in the theoretical investigation of the subject. I do not think that it will be found ultimately that there is any simple law for the distribution of the small polarizing particles about the sun. There appears to be no evidence tending to show that there is any concentric arrangement of matter in the corona, but there is a great deal of evidence to show that the matter is arranged radially, or rather in rays and great branching tree-like forms, some of which are very much inclined to the radial to the sun's limb. In fact, there is evidently no simple law which represents the arrangement of the luminous particles. Then again there are a good many interfering elements to be taken into account which could not easily be eliminated. The corona is observed through a highly polarized region of the atmosphere. The particles in the air between the observer and the corona are lit up by light derived from clouds upon the horizon outside the zone of totality, and the amount of the air polarization which overlies the corona polarization cannot be determined theoretically, as it depends upon local circumstances; then again, the coronal polarization would be affected by the unpolarized light emitted by the gaseous part of the corona, and also possibly by the incandescence of the polarizing particles themselves.

The President: The Society will return its thanks to Dr.

Schuster for his interesting paper, and perhaps I may add in reference to this matter of the corona the Society will be happy to hear that Mr. Ranyard has at last sent the Preface to the 41st volume of the Memoirs to the printer, and we hope we shall soon be in a position to distribute it to the Society.

Captain Noble: The sketches of Jupiter which I now present to the Society, were made on October the 4th and 18th of the present year, and to some extent they explain themselves. They show a very remarkable red spot and great dark equatorial belt. One point now to which I would call attention is in connection with the white spot visible south, following the red spot, on October 4th. A paper by Mr. Brett in June, 1876, directed attention to the fact that these bright spots sometimes throw a shadow; and on the night my sketch was made the spot in question not only cast a shadow (assuming the dark markings to be shadows,) but two were visible, one on the preceding edge and one on the following edge. I offer no explanation of this appearance. If you assume the spot to be a globular mass of vapour above the planet, it is quite evident it would throw a shadow behind it, but upon what principle there should be simultaneously another in front of it, I am at a loss to understand. The definition was superb, and the appearance of Jupiter was something like those lithographic or copper-plate engravings we have in books on astronomy. (Laughter.)

Mr. Dunkin: That is, one of the ordinary white spots,

Captain Noble: Yes. I have no theory upon the subject. Mr. Brett's theory is that these white spots cast shadows, and he sustains that theory by saying the shadow falls where it ought to have fallen; but in my case, while I had a shadow where one ought to have been, I had also a shadow where it ought not to have been.

Mr. Ranyard: There is an old drawing by Mr. Lassell in the *Monthly Notices* with a shadow all around a central white spot, and I think they used to be referred to as small-pox markings. I was at one time interested in the question whether these red markings had any connection with the sun-spot period and made a collection of copies of drawings of the planets which are now in the library of the Society. I came to the conclusion from an examination of these drawings that there seemed to be some connection, at all events as far as the evidence with regard to some of the recent sun-spot periods goes, and we are now coming again towards a period when the sun-spots are increasing in number, and here is one of these great red markings. As far as my memory serves me, all these elliptical markings have been seen in the southern hemisphere of Jupiter.

Mr. Neison: On the night that Captain Noble was making a drawing of Jupiter, I was observing the planet under very good conditions, and I saw the red mark that has been referred to and the white spot with a dark mark all around it. It looked bright and distinct, and like a white cloud upon Jupiter; but there was distinctly a dark shadow all around it which threw it into relief.

Mr. Common: The night before last I saw a white spot with a decided dark shadow on one side. I do not know on which side the shadow was, but I noticed it was there, and I noticed also that this great belt is getting very much darker than it was a few months ago.

Mr. Sadler: I think these shadows and white spots, which are like satellites in transit, were discovered about 20 years ago, and noticed in one of the volumes of the *Monthly Notices*.

Mr. Stone: There were a large number of drawings made by Mr. Carpenter at Greenwich when I was there, which show these markings distinctly. It is almost a pity they are not collected. These markings apparently are liable to great changes either from changes of definition, or in themselves. There is a long series of valuable drawings of them made with the great equatorial lying in the archives at Greenwich.

Mr. Dunkin: Also in the *Monthly Notices* there are some excellent drawings of Jupiter by Mr. Dawes, and Mr. Lassell which show these circular markings very distinctly indeed. I think you will find Mr. Dawes's drawings in the *Monthly Notices* for 1857. They show nearly all the phenomena noticed at present.

Mr. Christie: With reference to Mr. Stone's remark, we have lately been considering whether we can photograph those drawings of Mr. Carpenter's. There is an extremely valuable series of the planet Mars for 1861, and a series of drawings of Jupiter, but the difficulty is that the drawings are in colour. In the case of Mars the yellow disk would interfere with the photographing. At present it seems rather a difficult matter to get over, but Captain Abney has promised his assistance, and we hope to produce them in course of time. We have taken some photographs of the drawings made in 1877, so that they may be available for distribution to a limited extent. A complete set has been placed upon this card, and presented to the Society.

Mr. Penrose: Has anyone taken spectroscopic observations of the red spot on Jupiter?

The President: I have not heard or seen of any such observations. It would be an interesting observation if it could be made.

Mr. Christie: I think it would be a very difficult one. We made many attempts with Mars, but it was extremely difficult to separate the spectra coming from different parts of the disk.

Captain Noble: Said with reference to the remarks about the white spots, my intention was not at all to call attention to the fact that white spots were visible on Jupiter, (I was familiar with the drawings by Mr. Lassell, and Mr. Dawes) but to the fact that what are asserted to be shadows exist on both sides of these spots, and therefore cannot be shadows.

Thanks were voted to Captain Noble for his paper.

Mr. Neison, when called on to read a note *On the semi-diameter of the moon*, said: When Professor Pritchard at the last meeting of the Society read a paper on the diameter of the moon, obtained by measuring the photographs taken at Oxford, in drawing attention to the importance of the subject, I asked leave to postpone my remarks to the present day when I should have had an opportunity of seeing the paper in print. I am disappointed to find that the paper contains no information as to the all-important details, but merely gives bare results, without any real clue as to how they were derived. It simply says that the results were obtained in an analogous manner to the way in which some similar determinations were made 30 years ago. It then leaves you in the dark as to whether any modifications have been introduced which might vitiate the results.

In my present note I draw attention to the fact that, from the reduction of a very large number of measures of the diameter of the moon made at different observatories, I was able to deduce an empirical formula which closely represents the mean semi-diameter which has been obtained at these observatories, and closely agreeing with what theoretically might be supposed to be the true value. This formula gives for the semi-diameter of the moon, which I should expect would be given by the measurement of the Oxford photograph, a value closely agreeing with that obtained Professor Pritchard. In his paper, Professor Pritchard remarks that the value obtained from the Oxford photograph agrees closely with the value used in the *Nautical Almanac*. In this he appears to be mistaken, for the value used in the *Nautical Almanac* is Hansen's value, which differs by two-thirds of a second of arc from the value found by Professor Pritchard. Again, Professor Pritchard compares the separate results obtained by him with the separate results obtained with the heliometer, by Wichmann, more than 30 years ago. From this comparison he seeks to show that the measurement of the photographs are more accurate than measures with the heliometer. This is a point of some importance, because at the present moment Professor Pritchard and Professor Winnecke are engaged on the investigation of the same problem, the real libration of the moon, the former using measurements of photographs and the latter

measurements with the heliometer. It is only fair therefore that it should be pointed out that the comparison made by Professor Pritchard is not a just one. When the results obtained wtth the heliometer are properly amended, so as to be really comparable with those obtained from the photographs, it will be found that one is fully as good as the other.

There is another subject which I should like to refer to, though foreign to my present paper. In the last number of the *Monthly Notices*, Mr. Lynn has a note showing that according to the observations made at Greenwich, in 1878, there has been another sudden change in the error of Hansen's tables. Of late the error has been increasing at the rate of nearly a second of arc a year. Professor Newcomb and others have considered it as a matter of certainty that the error would continue to increase. In a paper read before the Society some time back, I pointed out that the rate of increase was rapidly diminishing, and that the error was likely to remain constant. But according to Mr. Lynn's paper, in 1877 and 1878 it has begun a rapid decrease. If the value contained in Mr. Lynn's paper truly represents the error in mean longitude, it is of a most important character, for it clearly shows that what is wrong in Hansen's tables is not the term of long period due to Venus, but is due to the absence of some important term of short period, which remains to be discovered. What then I want to ask Mr. Lynn is, whether the apparent error contained in his note, is really equivalent to the error of mean longitude, for if during the year there were an excess of observations made before full moon, or more made in the first six months than in the last six months, the mean error for the year would not truly represent the error of mean longitude. Under these circumstances the apparently rapid decrease might be merely imaginary and arise from the errors of short period existing in the tables.

Mr. Christie: With regard to Mr. Neison's empirical correction, how does he apply the correction for the personal error of the observer, because that seems to be the real difficulty in determining the diameter? Mr. Lynn has been putting together a number of determinations of the diameter with the altazimuth and the differences are very serious, 3 or 4 seconds of arc between the different observers. With regard to the very important point of the determination of the moon's error, I think, as far as I have examined the observations, it is fully borne out. If, as Mr. Neison has pointed out, the observations were not equally distributed over the year, and throughout the lunation we might have some discordance, but it would be merely apparent. I really think the observations are fairly distributed; but you have only to glance

through the moon's errors as shown at the Greenwich observations, to see that there is a very great diminution. But we ought to go back farther than 1877, two or three years before, I find the moon's errors began to diminish.

Mr. Dunkin: Supplementing Mr. Christie's remarks, it is remarkable that the moment Mr. Lynn published his paper, the errors began to increase (laughter), and since June the errors were almost as large as three years ago. It is difficult to know the cause of all this.

Mr. Stone: I think we may take it as pretty well established that the semi-diameter is a thing that depends on the telescope and perceptibly the diameter of the object glass, as one of the elements, and almost the principal one. Personality is also a very serious thing; and that has been known a great number of years. We had a remarkable instance of this when I was at Greenwich. When you take several observations and discuss them, and take the mean result, they come out perfectly well, but if you do not take the precaution to use the man's own semi-diameter, but mix them up, your results are entirely vitiated. Personality is a very strong element.

Mr. Dunkin: Ten years ago I published a short paper in the *Monthly Notices*, on the errors of right ascension given by the first and second limb of the moon as determined by different observers. It is curious that at a glance we can see at Greenwich by whom an observation is made simply because of the personal equation of the observer. It is difficult to get the true diameter of the moon, and we at Greenwich use two different diameters—one with the transit circle and one with the altazimuth. Both cannot be right. Therefore, if you want a proper observation, you must get the diameter for every telescope you use. What we want is to get some normal telescope and some normal semi-diameter.

Mr. Neison: The empirical formulæ I have been led to shows that the diameter will vary with different telescopes, and gives a diameter of more than half a second greater for the altazimuth than for the transit circle. As regards the charge of error of the moon in 1878, the year was an exceptional one in so far as the weather, and it is not impossible that under these circumstances the mean error of the year does not correspond to the error of mean longitude. It is most important though that the point should be settled, and we should know what was the error of mean longitude of Hansen's tables in 1870.

Mr. Christie: I should like to mention that Mr. Maunder has succeeded at Greenwich, with the 12¾-inch refractor, in getting an observation of Deimos, the outer satellite of Mars. It is

interesting as showing that the satellite is not such a very difficult object as might be supposed. The observations were made with a bright line micrometer and illuminated wires, without any great difficulty, near the time of elongation.

Mr. Dunkin: So that Mr. Maunder's and Mr. Common's observations at present are the only ones.

Mr. Christie: As far as I know, but other observers very likely have made observations.

The President: I have seen the satellite, but was not able to measure it, as a cloud came on. It has been seen distinctly at Dun Echt.

Mr. Ranyard: I think Mr. Common has made several observations.

Mr. Common: Yes, a series of observations extending from September 21 to last night. During four or five nights perhaps we took 20 or 30 measures in the night. So far as my experience goes, any one who can see Enciladus can with ease see both satellites of Mars at elongation, if they will take the precaution to hide the planet. I have been surprised at the brightness of Deimos at elongation. It is quite as bright as Enciladus. There is an ephemeris published of Mars, and moving as quickly as it does one certainly ought to determine in an hour or two whether it is the satellite you are observing.

Mr. Christie: Mr. Maunder s measures were made by viewing Mars through a dark glass which covered half the field,—a dark glass placed in front of the field lens, and in that way diminishing the glare of the planet.

The following papers were also announced:

Major J. Herschel: *Note on the difference of variation of gravity at Revel and St. Petersburg, and on Grischow's pendulum observations at other stations.*

Prof. W. Harkness: *On the physical configuration of Mars.*

W. T. Lynn: *On the change in the mean error of longitude of Hansen's lunar tables since* 1876.

Astronomer Royal: *Mean areas of umbræ, whole spots and faculæ upon the sun's disk, as measured on photographs taken at the Royal Observatory, Greenwich, for each rotation of the sun from* 1873, *July* 11.

Prof. Tacchini: *Observations of Comets Palisa and Hartwig made with the Merz equatorial of the Collegio Romano.*

R. L. J. Ellery: *Conjunction of Mars and Saturn, observed at the Observatory, Melbourne.*

R. Wilding: *Comparison of Hansen's co-efficients of the Moon's latitude with those of Plana, Damoiseau, &c.*

Maxwell Hall: *The Zodiacal light.*

A. Bowden: *Description of a self-registering micrometer.*

Lord Lindsay: *Observations of Comet* 1879, *d.* (*Palisa*) *made at Dun Echt Observatory.*

Lord Lindsay: *Observations of the spectrum of Comet,* 1879, *d.* (*Palisa*).

G. Calver: *On the working of the speculum for the* 37*-inch reflector.*

Prof. A. Winnecke: *Observations of the Solar Eclipse* 1879, *July* 18*th, made at the University Observatory, Strasburg.*

The meeting adjourned at ten o'clock.

REVIEWS.

A Handbook of Double Stars, with a Catalogue of 1,200 *Double Stars and extensive Lists of Measures.* With additional notes, bringing the measures up to 1879. For the use of amateurs. By Edward Crossley, F.R.A.S., Joseph Gledhill, F.R.A.S., and James M. Wilson, M.A., F.R.A.S. pp. xiv. 464. 21*s.* Macmillan & Co. 1879.

This is truly a delightful work, and one which will admirably supply a want which must have been long felt by double-star observers. Into the hands of abler, more impartial, and painstaking observers and compilers than the authors its preparation could not have fallen, and the expense, trouble, and anxiety necessarily involved in it, will, we hope, be rewarded by an extensive circulation, and the grateful appreciation of astronomers. Nothing, we think, could have been more seasonable than the appearance of this handsome volume, with its immense mass of observations, its lucid instruction, and copious information gathered from sources inaccessible to most amateurs. We could gladly quote largely from it, but that we feel persuaded that every one interested in this fascinating department will, if possible, procure it, and, having done so, will soon regard it as one of the most indispensable books in his collection. Amongst other things, besides the catalogues, are an historical introduction, construction and adjustments of the equatorial and micrometer, methods of observing, calculation of the orbit of a binary star by a graphic method, with an example, an example by Dr. Doberck of an orbit worked by analytical methods, and the bibliography of the whole subject. There are six illustrations, five plates, and 26 diagrams, 24 of the last being delineations of the apparent orbits of double stars. We may say that the authors will be most grateful for lists of errors, mistakes, or faults and short-comings of any kind; in a word, of any suggestions for the improvement of the book. That some misprints should occur in such a work is inevitable; a few are noted by the authors, and we have noticed that $-\frac{\Delta t}{2}$ p. 99, should be $-\frac{\Delta^2 t}{2}$; column six seems wanting on p. 107, and the heading of column five, p. 152, is wanting. We will only add that the arrangement of the matter is so good, that whilst a great amount is compressed within a moderate compass, the whole is beautifully clear. Nor is anything in regard to type and paper wanting to render the book one of easy and ready reference by day or night.

Annals of the Astronomical Observatory of Harvard College. Vol. XI. Part I.: Photometric Observations made principally with the Equatorial Telescope of 15-in. aperture during the years 1877—79. By

Edward C. Pickering, Director, aided by Arthur Searle and Winslow Upton, assistants in the observatory. Printed from the Sturgis Fund. University Press: John Wilson and Son, Cambridge. 1879. pp. vi. 189.

The entire series of observations consists of over twenty-five thousand measurements, arranged in five thousand sets. Previous methods, such as Zöllner's, &c., having been found defective, twelve new kinds of photometers, including modifications, were used. These are illustrated by woodcuts, one of which, by the kindness of Prof. Pickering, we here reproduce. It is represented in perspective in Fig. 5, and in section, on a

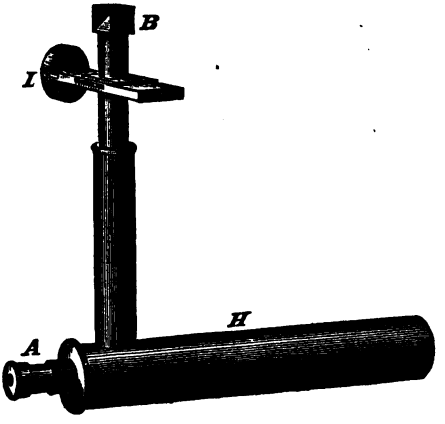


Fig. 5.

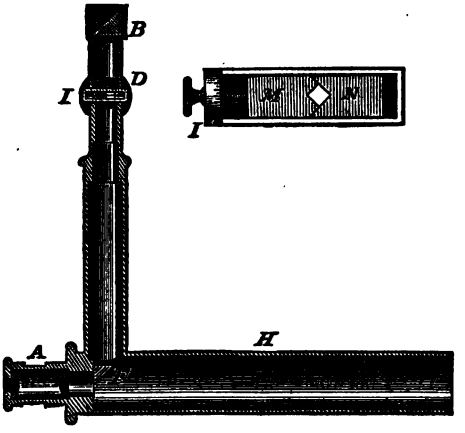


Fig. 6.

scale of one-fifth, in Fig. 6. The arrangement of M N was made by taking out the lenses of a double-image micrometer, and attaching two V-shaped pieces of brass to the slides carrying the divided lens. A square hole, or "cat's eye," was thus formed, whose dimensions could be altered at will, by turning the micrometer screw. Placing it near the objective D, the light was varied by changing the aperture of the small telescope. The faint object is viewed with the eye-piece A, while the light of the bright object, passing down the side of the telescope, is reflected by the prism B into the object-glass D, whose aperture is varied by the screw I, which moves the plates M N. Finally, the prism F throws the light into the field of A. The whole is attached to the tube H, which slides into the end of the telescope. This photometer is light, can be easily removed, and by a suitable adapter may be attached to any telescope. This class of photometers can be used only in the measurement of faint stars. If the image of the object seen in the large telescope is brighter than that formed by the auxiliary telescope, no setting of the Nicol's or micrometer screw will render them equal. This difficulty was obviated by another photometer.

It is impossible in our limited space to do justice to this very valuable work. It displays ingenuity, resource, and unsparing pains to arrive at the greatest possible accuracy, and guard against every likely source of error. As a rich contribution to an important, but difficult and delicate branch of astronomy, it will be highly appreciated. Large telescopes have been hitherto little used in photometry, and, as the able Director of Harvard College Observatory remarks, "a new class of instruments had to be invented and constructed, and the lack of previous observations prevented the comparison of results, which generally forms so convenient a test of the quality of a scientific research." We transcribe a few conclusions which will be interesting to our readers. The relative brightness of Saturn and Mars, Jupiter and Venus, at their conjunctions in 1877, was determined by 600 comparisons of the two former, and 300 of the two latter. No telescope was employed, as the light, even when reduced by the prisms, was more than sufficient for the most accurate comparison. Saturn was found to reflect nearly five times as large a proportion of the incident light as Mars. If the *Albedo* (by which term this comparative proportion of reflected light is designated) of Saturn is taken as unity, that of Mars becomes ·216, with a probable error of ·003. This is on the assumption that the diameter of Mars at distance unity is 10″·10, but great uncertainty exists concerning this constant. The albedo of Jupiter is ·86, with a probable error of ·02, that of Venus being taken as unity. Photometric observations were made of all the bright double stars visible at Cambridge. Vol. I. of the Dun Echt Observatory Publications proved very useful. At least ten sets of observations, distributed over three or more nights, were taken for the measurement of each star. An extensive table (IV.) contains the ledger of these stars. It has 239 sections, in one or more of each all the observations relating to the same object are brought together. Table V. gives the results of Table IV. in the form of a catalogue. A selection of some stars, omitting many of the columns of this catalogue, is here given. The magnitudes and distances are those of Struve. The differences in magnitudes are the means of the observed magnitudes in Table IV. of this work. The column headed "ratio" gives the light of the bright star in terms of the light of the faint star. Next follows the average deviation in magnitudes of the individual measurements of each star in Table IV. from their mean. Lastly, the probable error of the mean value of the observed differences in magnitude.

Name.	Mag. A.	Mag. B.	Dist.	Diff. in Mag.	Ratio.	Average Dev.	Prob. Error.
			"				
η Cassiopeiæ ...	4·0	7·6	9·7	3·85	34·70	·16	·05
α Ursæ Minoris...	2·0	9·0	18·3	6·57	425·0	·12	·03
γ Andromedæ ...	3·0	5·0	10·3	2·85	13·80	·09	·03
β Orionis	1·0	8·1	9·1	6·25	316·0	·27	·08
λ Orionis	4·2	11·2	15·0	7·17	738·0	·19	·05
α Canis Majoris			10·	10·02	10200	·45	·11
α Geminorum ...	2·7	3·7	4·4	·82	2·130	·23	·07
ζ Cancri	5·0	5·7	1·1	·93	2·350	·09	·02
γ Leonis	2·2	3·6	2·5	1·19	2·990	·16	·05
γ Virginis	3·0	3·0	2·4	—·03	·973	·13	·03
12 Canum Venat.	3·4	5·6	19·9	2·63	11·30	·17	·05
ε Boötis	3·3	6·6	2·6	2·41	9·200	·19	·05
α Serpentis ...	2·5	15·0	50·	10·22	12200	·50	·14
α Herculis... ...	3·0	6·1	4·6	2·24	7·870	·23	·06
α Lyræ	1·0	10·5	43·0	9·97	7730	·23	·06
110 Herculis ...	5·0	16·0	55·	8·91	3600	·32	·09
β Cygni	3·5	5·6	34·3	2·14	7·180	·14	·04
γ Delphini... ...	4·0	5·0	11·9	·99	2·490	·11	·03
61 Cygni	5·1	6·0	15·3	·80	2·090	·09	·03
ζ Aquarii	4·0	4·3	3·6	·18	1·180	·16	·05

Even a wide difference in colour is found to influence very slightly the estimate of magnitude by different observers. The cases of η Cassiopeiæ, γ Andromedæ, and β Cygni are marked illustrations. ε Boötis is a good specimen of the close doubles with components of unequal magnitude, which require good seeing for satisfactory measurement. α Lyræ and α Ursæ Majoris, with components differing very greatly in brightness, and λ Orionis, an example of a very faint star—12 magn. is the highest in Struve's scale—form classes which, with others, are subjected to rigorous discussion, and results are tabulated in various ways, yet their measurement proves as reliable as that of 12 Canum Venaticorum, which belongs to bright and easily measured pairs. Prof Pickering observes that "the proximity of a bright star greatly reduces the apparent brightness of a faint object, and thus renders it difficult to estimate its light correctly." Thus in the case of the pole star, the two images of which were placed at various distances apart, and the light of one reduced until it appeared equal to the companion, it appeared from measurements by himself and Mr. Searle that a variation of even three magnitudes might be made in estimating the brightness of a companion of a star of the second magnitude, if the distance varied from 5" to 60". When the bright image of the pole star was placed outside the field the error was much reduced. On one occasion two of the satellites of Saturn, one very near and the other at some distance from the planet, appeared to the eye of two observers very nearly equal. Measurement with the photometer, however, showed that the nearer satellite really exceeded the other in brightness by 1·30. Subsequently these were identified as Titan and Rhea, the former being the nearer one. Their true difference in brightness is 1·4 magnitudes. In a series of measurements the light of Sat. I. of Jupiter for several minutes before and during occultation was compared with Sat. II., and it appeared that no sensible variation took place in the light of the satellite, and that the apparent reduction is due to the proximity of Jupiter, and not to the absorption of an atmosphere. The mean difference in magnitude was ·41. Observations were also made on the variation in brightness of Jupiter's

disk, which as far as they go—for the observation is difficult—"throws doubt on any considerable diminution of light at a distance from the edge greater than two or three seconds. Admitting that the edges of the disk are really darker than the centre, it does not necessarily follow that this must be due to an atmosphere extending to a height sufficient to be visible beyond the apparent surface of the planet. . . We may conclude, therefore, that there is no evidence of an atmosphere extending beyond the visible disk, and that the reduction in light of satellites and faint stars is subjective and not due to absorption."

"It is not uncommonly supposed that the companion of Sirius shines merely by reflected light. If the irregular proper motion of this star is accounted for by its revolution around its companion, it is evident that the intrinsic brightness of the latter must be far less than that of Sirius. The alternative of assuming that the difference is due to the greater density of the companion is too improbable to deserve consideration. The measurements given in Table IV. show that if the objects had equal mass and equal intrinsic brightness, the density of the companion must be a million times that of Sirius. . . If the light is wholly due to reflection from Sirius, we can compute the minimum angular diameter of the disk, and then see whether it would be possible to detect it by its appearance in a telescope with a high magnifying power." The mathematical investigation which follows, on the supposition that the light is proportional to the varying area of the illuminated portion, as in the case of our own moon, shows that the apparent diameter of the companion would be not less than 0″·52, and its disk could hardly fail to be visible. Its real diameter would exceed that of the orbit of the earth. The conclusion seems to be that if the companion presents a maximum diameter of less than 0″·5 it must shine in part by its own light. Of course in any case a part of its light will be reflected from Sirius.

The difference in the spectrum of the two components of β Cygni, believed to be the first quantitative measurement of the distribution of light in the spectrum of a star, is given in tables IV. and V., of which the following is an abridgment:

Colour of Images.	Diff. in Mag.	Ratio.	Average Dev.	Prob. Error.
Red...	2·22	7·730	·21	·09
Yellow	2·02	6·430	·12	0·5
Green	1·65	4·570	·11	·05
Blue	·93	2·350	·16	·07
Indigo	·63	1·790	·23	·10
Violet	·39	1·430	·13	·11
Observations on γ Andromedæ are as follows:				
Red...	3·07	16·90	·03	·01
Yellow	3·14	18·00	·19	·08
Green	2·71	12·10	·22	·09
Blue	2·61	11·10	·23	·10
Indigo	1·74	4·970	·57	·28

The parts of the spectra selected were those where the colour was such that the wave-length was estimated to be about 65, 60, 55, 50, 45, and 40 millionths of a centimetre. A series of measurements was made to show what accuracy was to be expected in determining the light of a star by the limit of its visibility. It appeared that a variation of several magnitudes is to be expected in the observations by different persons on different days. Although, doubtless, better accordance might be attained by

practice, it is not probable that this method would ever equal the accuracy attained in the direct comparison of two stars.

It has been shown that magnitudes can generally be well represented by a logarithmic scale, in which equal divisions will correspond to equal ratios in the light. The scale of magnitudes adopted in this work is that of Pogson (*Monthly Notices*, XVI. 13) who has shown that a scale closely agreeing with that commonly employed in eye-estimates may be obtained by the use of 0·4 as a divisor of the logarithmic ratios.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.
To all communications must be annexed the name and address of the sender, as a guarantee of good faith.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

MARS.

Sir,—This planet has been observed on every favourable occasion, with the hope of identifying the details of the map published in the *Memoirs* of the Royal Astronomical Society. Opportunities have been few and definition peculiarly difficult to obtain, still the results are fairly satisfactory.

The first drawing was made on October 20th. Since this date the whole surface of Mars has been presented for inspection, and attention has been specially given to the portions near the equator. All the named markings, with very few exceptions, have been re-observed. From Christie Bay westward to Huggins Bay every point has been re-drawn, Niester Isthmus only being uncertain.

From Trouvelot Bay and Noble Cape, southwards, each alternate band of light and dark has been distinctly visible, with the exception of Joynson Sea, which may be presumed too near the limb for recognition.

The surroundings of Terby Sea have been found the most difficult to observe. Lake Schiaparelli only suspected, though Mr. Burton has drawn a form exceedingly like it on October 24th, 13h. 45m. To the north of Terby Sea, a marking which appears on the drawings of Kaiser, Dawes, and Lockyer, but which was very faint during the opposition of 1877, is again visible. In Mr. Proctor's map it was named Dawes Sea.

Hall Island and Mitchell Mountains are the only remaining forms of which a view has not been obtained.

A series of valuable views have been received from Mr. Burton, Capt. Noble, and Mr. Dennett—any others, especially of Terby Sea and surroundings, will be most welcome.

39, Circus Road,
St. John's Wood, London.

Yours respectfully,
NATHL. E. GREEN.

LUNAR CORONA.

Sir,—As I was experimenting on the actinic power of lunar light, I obtained on the 27th August, 1879 (period of full moon), at 7 p.m., a photographic negative which displayed a bright and well defined ring of light around, but at a considerable distance from the moon, which was not visible to the naked eye nor on the ground glass of the camera, nor on the lens at the time of the observation. This is a photograph of the appearance:

Since then I have taken several photographic observations under various conditions. I have no clock-work arrangement, but use an ordinary camera, with one of Ross's symmetrical landscape lenses, and allow the moon to traverse the exposed dry plate (Swan's). I have taken observations of the moon in all her phases, and tortured the lens with dew and puff-ball powder, and exposures with flying scud, but never got a ring, nothing more than burr.

The next full moon there was total obscurity, and I failed to get an observation then, but on Oct. 30, at 10 p.m., I got a solitary observation clear, and another impression on the same plate fifteen minutes after, when the moon was covered with scud and displayed beautiful prismatic halo. This is the photograph of that observation:

Why does a ring appear only at full moon? Why is it invisible to the naked eye? Has it any connection with what Mr. Newall observed round Mars? and why should it be dark close to the moon and bright beyond, so different from that produced by an artificial or natural atmospheric halo? That this singular appearance is interesting is beyond doubt, but whether the cause is atmospheric or cosmical, whether caused by refraction, diffraction, or interference of light, are questions I leave to practical astronomers

to solve. In the meantime I shall be glad to forward to any of your readers anxious to study the matter copies of the photographs, at the same time I would urge all who can to try for themselves, and to embrace ample space round the moon.

7, Thornhill Crescent, Yours truly,
Sunderland: Nov. 7, 1879. GEORGE BERWICK.

THE SPOT ON JUPITER.

Sir,—As a supplement to the information given on page 268 of your last number, your readers may be glad to be referred to your numbers 107, 109, and 116.

In the first of these there are drawings of Jupiter by Mr. Crossley, most of which show a spot of a somewhat similar character.

In No. 109 there are other drawings of Mr. Crossley's, one of which exhibits a very remarkable forerunner of the spot now visible.

In No. 116 is a letter of Mr. Browning's speaking of his drawings of this planet, in which he says, "In several instances I had drawn nearly oval markings on the southern edge of the equatorial belt," but, he goes on to say, that owing to their being very badly defined he found himself compelled to omit them.

Appleby, Lincolnshire: I am, faithfully yours,
Nov. 4, 1879. J. E. CROSS.

THE NOVEMBER METEORS OF 1877.

During the 12th a watch was maintained from 9h. 30m. to 16h The sky remained cloudless throughout the night. 28 meteors were seen, nine of which appeared between 12h. 30m. and 13h. The greater number of them were small, left little or no train, and were traceable but a very short distance. Six, however, were conspicuous; of these one at 10h. 20m. pursued a curved path from α Geminorum to λ Tauri, lasting five seconds, and being accompanied by an exceedingly bright train; at 13h. 26m. a brilliant meteor was traced from 30 in Leo Minor to ξ Ursæ Majoris.

On the night of the 13th those who expected only some portion of the usual meteoric shower must have been greatly disappointed, for notwithstanding the most favourable weather and a slight increase in numbers during the early part of the night, fewer meteors were observed than on the 12th. In the portion of the sky which was under observation from 10h. to 17h. only 25 were seen, and of these only four could be called brilliant. The results of the 14th were rather more satisfactory. Part of the sky was observed

from 7h. to 8h. 30m., and from 9h. 30m. to 18h. 38 meteors were seen, and at 14h. and 17h. they followed in somewhat quick succession; 10 were notably bright, and one equalled Venus in size and brilliancy. The times and directions of the principal ones are—

h.	m.		Duration.
10	28	β Geminorum to ζ Cancri	2 seconds.
11	13	θ Geminorum to λ Cancri	3 ,,
13	22	θ Geminorum to λ Cancri accompanied by a slight train.	3 ,,
15	19	θ Leonis to ϵ Virginis	2 ,,

Of these whose paths were recorded most radiated from Leo; of the remainder many were traceable from the region around α and β Geminorum, but I was unable to give the exact position of the radiant.

During the three nights the total number of meteors observed by myself and an assistant was 92.

T. P. GRAY.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN DECEMBER, 1879.

By W. R. Birt, F.R.A.S., P.S.S.

The *Selenographical Journal* for November 14, 1879, contains notices of the following lunar formations for observation in December: Taruntius, the Mare Nectaris [we may add Fracastorius, especially the east wall, the shallow crater (at the extremity of the continuation of the east wall) situated nearly on the Mare and Richards's ridge, connecting the shallow crater with the wall. The east wall of Fracastorius is full of interest], the Mare Serenitatis [this is a large object, and we cannot do better than to refer the observer to the monogram of the Mare which is in the library of the Royal Astronomical Society for interesting objects which it contains. Linné should not be overlooked, measures of which are very desirable], Ritta and Sabine, and rills (clifts) in their neighbourhood. Particular attention is requested to Hyginus and its neighbourhood on the night of Dec. 4, as the evening terminator will then pass over the region, and a good opportunity will be afforded for observing sunset on it. The group Pallas, Bode, etc., may form an interesting subject for observation on the night of Dec. 5. Sunset on Copernicus occurs on the night of Dec. 7. [We are not aware that any good drawings exist of the late illumination of this magnificent formation.]

The above-named objects may be advantageously observed between full and last quarter of the lunation Nov.—Dec., 1879. Day elapsed of Julian Period, Dec. 1, 240·7685; Dec. 8. 240·7692; Dec. 15, 240 7699; Dec. 22, 240·7706. The day elapsed of the Julian Period should be appended to each observation.

Streaks from Proclus. We have been favoured with an interesting observation of Schröter's northern streak. The space on the Mare Crisium,

between Peirce and Peirce A, was occupied by a soft, light, diffused tint, and on this was seen a thin, narrow, brilliant white line, which extended from the south edge of Peirce A to the eastern border of the Mare Crisium. Further particulars will be given in a future list. In the meantime should any of our readers have noticed such an appearance between the two craters above mentioned, or should it be detected during the next or any future lunation, a notification of it addressed as below will oblige.

Water Lane, Stratford, E.:
November 17, 1879.

THE PLANETS FOR DECEMBER.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury...	1st	17 42 53	S. 24 32	8″·4	1 2·8
	9th	17 14 27	S. 21 41½	9″·8	0 3·0 23 53·4
	17th	16 36 10	S. 19 4½	8″·8	22 49·5
	25th	16 44 45	S. 19 53½	7″·2	22 26·6
Venus ...	1st	13 28 39	S. 6 56½	25″·2	20 45·4
	9th	14 0 12	S. 9 31½	23″·0	20 45·4
	17th	14 33 28	S. 12 10	21″·2	20 47·1
	25th	15 8 24	S. 14 43	19″·8	20 50·5
Mars ...	1st	2 46 38	N. 17 10½	20″·2	10 5·1
	9th	2 41 46	N. 17 5½	18″·8	9 28·8
	17th	2 40 25	N. 17 12½	17″·2	8 56·0
	25th	2 42 28	N. 17 31	15″·8	8 26·6
Jupiter ...	1st	22 27 57	S. 10 55½	37″·4	5 47·1
	9th	22 31 28	S. 10 33½	36″·6	5 19·1
	17th	22 35 36	S. 10 8	35″·6	4 51·8
	25th	22 40 17	S. 9 39	35″·0	4 25·0
Saturn ...	1st	0 37 24	N. 1 12	17″·0	7 56·2
	9th	0 37 1	N. 1 11½	16″·8	7 24·4
	17th	0 37 2	N. 1 14	16″·4	6 52·9
	25th	0 37 29	N. 1 19	16″·2	6 21·9
Neptune ...	3rd	2 32 8	N. 13 2	...	9 42·8
	19th	2 30 52	N. 12 56½	...	8 38·6

Mercury is too near the sun at the beginning of the month to be well observed. Towards the middle of the month he rises an hour and a half before the sun, the interval increasing.

Venus rises about four hours and a half before the sun, at the beginning of the month, the interval decreasing

Mars may be observed throughout the night, setting about an hour and a half before sunrise on the 1st, the interval rapidly increasing.

Jupiter sets about an hour before midnight at the beginning of the month, and afterwards earlier each night.

Saturn sets about two hours after midnight, at the beginning of the month, the interval decreasing. On the 31st he sets a quarter of an hour after midnight.

ASTRONOMICAL OCCURRENCES FOR DECEMBER, 1879.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
			Sidereal Time at Mean Noon 16h. 39m. 53·25s.	1st Tr. I.	4 38	Mars.
Mon	1			1st Sh. I.	5 59	—
		10 20	Occultation of 44 Geminorum (6½)	1st Tr. E.	6 57	10 5·1
				1st Sh. E.	8 17	
		10 38	Reappearance of ditto			
Tues	2	15 7	Occultation of B.A.C. 2683 (6)	1st Ec. R.	5 35 51	
				3rd Tr. I.	6 44	10 0·4
		16 23	Reappearance of ditto	3rd Tr. E.	10 19	
Wed	3	13 14	Occultation of 54 Cancri (6½)	2nd Tr. I.	8 8	9 55·7
		13 17	Reappearance of ditto			
Thur	4	14 22	Occultation of o Leonis (3½)			9 51·1
		15 18	Reappearance of ditto			
Fri	5		Sun's Meridian Passage 9m. 17·17s. before Mean Noon	2nd Ec. R.	7 47 39	9 46·5
Sat	6	7 43	☾ Moon's Last Quarter	3rd Ec. R.	5 30 42	9 42·0
			Saturn's Ring: Major axis=41″·91 Minor axis= 5″·44	4th Sh. I.	8 56	
Sun	7			1st Oc. D.	9 27	9 37·5
Mon	8			1st Tr. I.	6 35	
				1st Sh. I.	7 55	
				1st Tr. E.	8 54	9 33·1
				1st Sh. E.	10 13	
Tues	9	20	Conjunction of Moon and Venus 8° 2′ N.	1st Oc. D.	3 56	
		23	Inferior conjunction of Mercury and Sun	1st Ec. R.	7 31 27	9 28·8
Wed	10			1st Sh. E.	4 41	9 24·5
Thur	11					9 20·3
Fri	12	23 4	● New Moon	2nd Oc. D.	4 59	9 16·1
Sat	13			3rd Ec. D.	6 18 50	9 12·0
				3rd Ec. R.	9 32 1	
Sun	14			4th Oc. D.	3 52	
				2nd Sh. E.	5 38	9 7·9
				4th Oc. R.	8 19	
Mon	15		Illuminated portion of disc of Venus=0·557	1st Tr. I.	8 33	
			Illuminated portion of disc of Mars=0·954	1st Sh. I.	9 50	9 3·9
Tues	16		Sidereal Time at Mean Noon 17h. 39m. 1·62s	1st Oc. D.	5 54	
				1st Ec R.	9 27 1	8 59·9
Wed	17		Sun's Meridian Passage 3m. 45·68s. before Mean Noon	1st Sh. I.	4 19	
				1st Tr. E.	5 22	8 56·0
				1st Sh. E.	6 37	

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Thur	18	11	Conjunction of Moon and Jupiter 5° 49′ S.	1st Ec. R.	3 55 56	Mars. 8 52·2
		23 15	☽ Moon's First Quarter			
Fri	19	10 56	Occultation of κ Piscium (4½)	2nd Oc. D.	7 41	8 48·4
		11	Occultation of 9 Piscium (6)			
Sat	20			3rd Oc. D.	5 6	
				3rd Oc. R.	8 40	8 44·6
Sun	21	3	Conjunction of Moon and Saturn 8° 28′ S.	2nd Sh. I.	5 25	
				2nd Tr. E.	5 46	8 40·9
				2nd Sh. E.	8 15	
Mon	22	5 6	Occultation of 101 Piscium (6)			8 37·2
		5 49	Reappearance of ditto			
Tues	23	19	Conjunction of Moon and Mars 3° 8′ S.	4th Sh. E.	7 4	
				1st Oc. D.	7 53	8 33·6
Wed	24	15 4	Occultation of 66 Arietis (6½)	1st Tr. I.	5 1	
				1st Sh. I.	6 16	8 30·1
		15 44	Reappearance of ditto	1st Tr. E.	7 21	
				1st Sh. E.	8 34	
		5 52	Occultation of 36 Tauri (6)			
		6 43	Reappearance of ditto			
Thur	25	16 48	Occultation of 62 Tauri (6)	1st Ec. R.	5 51 25	8 26·6
		17 42	Reappearance of ditto			
		5 47	Near approach of B.A.C. 1518 (6)			
		6 24	Occultation of *h* Tauri (5½)			
Fri	26	7 25	Reappearance of ditto			8 23·1
			Saturn's Ring: Major axis=40″·47 Minor axis= 5″·35			
		5 12	Occultation of 132 Tauri (5½)			
Sat	27	6 11	Reappearance of ditto	3rd Oc. D.	9 23	8 19·7
		4 15	○ Full Moon	2nd Tr. I.	5 37	
Sun	28		Eclipse of the Moon visible at Greenwich	2nd Sh. I.	8 2	8 16·3
				2nd Tr. E.	8 30	
Mon	29					8 13·0
		6 58	Occultation reappearance of d^2 Cancri (6)			
Tues	30	19	Saturn at quadrature with the Sun	2nd Ec. R.	4 59 26	8 9·7
				3rd Sh. I.	4 24	
				1st Tr. I.	7 1	
Wed	31			3rd Sh. E.	7 47	8 6·5
				1st Sh. I.	8 11	
				1st Tr. E.	9 20	
2 JAN.	80					
Thur	1			1st Oc. D.	4 22	
				1st Ec. R.	7 47 3	8 3·3

THE INNER SATELLITES OF SATURN.

Major and minor semi-axes of the apparent orbits described by the satellites, expressed in semi-diameters of Saturn's equator.

		Mimas.	Encel.	Tethys.	Dione.	Rhea.
Major		3·14	4·03	4·99	6·40	8·93
Minor	Dec. 1	0·41	0·52	0·65	0·83	1·16
	11	·41	·52	·65	·83	1·16
	21	·41	·53	·65	·84	1·17
	31	·42	·54	·67	·85	1·19

Approximate Greenwich times of some of the conjunctions of the satellites with the centre of the ball and the ends of the ring, v. p. 216:

1879.	Gr. M. Time. h.		
Dec. 1	4·8	Tethys	np.
	6·1	Dione	np.
	9·9	Encel	np.
	9·9	Mimas	nf.
2	7·0	Dione	sp.
	8·5	Mimas	nf.
3	7·1	Mimas	nf.
	11·2	Encel	sf.
4	5·7	Mimas	nf.
5	5·5	Rhea	inf. n.
	5·8	Encel	nf.
	8·6	Dione	sf.
6	5·0	Encel	sf.
	9·1	Mimas	np.
	9·6	Dione	nf.
7	7·3	Encel	sp.
	7·7	Mimas	np.
	11·7	Rhea	sup. s.
8	6·3	Encel	np.
	6·4	Mimas	np.
	10·9	Tethys	nf.
9	5·0	Mimas	np.
	8·6	Encel	nf.
	9·5	Tethys	sp.
	10·1	Mimas	sp.
10	7·6	Encel	sf.
	8·2	Tethys	nf.
	8·8	Mimas	sp.
11	6·9	Tethys	sp.
	7·4	Mimas	sp.
	10·0	Encel	sp.
12	4·9	Dione	np.
	5·5	Tethys	nf.
	6·0	Mimas	sp.
	9·0	Encel	np.
13	5·8	Dione	sp.
14	6·3	Rhea	inf. n.
	9·4	Mimas	sf.
	9·9	Tethys	np.

1879.	Gr. M. Time. h.		
15	8·0	Mimas	sf.
	8·6	Tethys	sf.
16	5·1	Encel	nf.
	6·6	Mimas	sf.
	7·3	Tethys	np.
	7·4	Dione	sf.
17	5·2	Mimas	sf.
	5·9	Tethys	sf.
	8·3	Dione	nf.
18	4·6	Tethys	np.
	6·4	Encel	sp.
	9·0	Mimas	nf.
19	5·4	Encel	np.
	7·7	Mimas	nf.
20	6·3	Mimas	nf.
	7·7	Encel	nf.
	9·9	Dione	np.
21	6·7	Encel	sf.
22	9·1	Encel	sp.
23	7·2	Rhea	inf. n.
	8·1	Encel	np.
	8·3	Mimas	np.
24	4·6	Dione	sp.
	6·9	Mimas	np.
25	5·5	Mimas	np.
	9·4	Encel	sf.
26	9·4	Tethys	sp.
27	6·2	Dione	sf.
	8·0	Tethys	nf.
	8·0	Mimas	sp.
28	6·6	Mimas	sp.
	6·7	Tethys	sp.
	7·1	Dione	nf.
29	5·2	Mimas	sp.
	5·3	Tethys	nf.
	5·5	Encel	sp.
30	4·5	Encel	np.
31	6·9	Encel	nf.
	8·8	Dione	np.

A. M.

JUPITER.

1879.	Angle of position of 4's axis.	Latitude of Earth above 4's equator.	Latitude of Sun above 4's equator.	Equat. diameter.	Greatest phase.
	°	°	°	″	′
Dec. 6	336·27	+1·16	+1·60	38·90	0·55
16	336·07	1·18	1·64	37·75	0·51
26	335·85	+1·22	+1·68	36·72	0·45
1880.					
Jan. 5	335·63	1·26	1·72	35·81	0·38

The assumed First Meridian passes the middle of the illuminated disk at the following times:

1879.	G. M. T.					
	h. m.		h. m.		h. m.	
Dec. 1	9 58·6	Dec. 13	9 50·6	Dec. 26	5 34·3	
2	5 49·5	14	5 41·8	27	1 25·6	
3	1 41·0	15	11 28·6	28	7 12·4	
—	11 36·5	16	7 19·8	29	3 3·6	
4	7 27·7	17	3 11·0	30	8 50·4	
5	3 18·9	18	8 57·5	31	4 41·7	
6	9 5·6	19	4 49·0	Jan. 1	10 28·5	
7	4 56·8	20	10 35·8	2	6 19·7	
8	10 43·6	21	6 27.1	3	2 11·0	
9	6 34·7	22	2 18·3	4	7 57·8	
10	2 25·9	23	8 5·1	5	3 49·1	
11	8 12·7	24	3 56·3			
12	4 3·9	25	9 43·1			

About 3h. 20m. *before* these times the large reddish spot now visible on Jupiter's southern hemisphere will *begin* to cross the middle of the illuminated disk, and will take more than an hour in passing it.

A. M.

THE SATELLITES OF MARS.

Angles of position p_o of the major axes, and major and minor semi-axes *a b* of the apparent ellipses described by the satellites:

	Phobos.			Deimos.		
	p_o	*a*	*b*	p_o	*a*	*b*
	°	″	″	°	″	″
Nov. 30	51·48	23·80	6·89	52·61	59·56	17·87
Dec. 10	51·40	21·65	6·58	52·55	54·19	17·01
20	51·35	19·46	6·00	52·51	48·71	15·52

The satellites will be at their greatest "nf." and "sp." elongations about the following times:

	Phobos.		Deimos.		Phobos.		Deimos.
Dec.	h.	h.	h.	Dec.	h.	h.	h.
1	8·5 sp.	11·9 nf.	8·3 nf.	11	9·2 nf.		10·6 sp.
2	7·1 sp.	10·9 nf.	14·6 sp.	12	8·1 nf.	12·0 sp.	16·9 sp.
3	6·0 sp.	9·9 nf.	5·8 nf.	13	7·1 nf.	10·9 sp.	8·1 nf.
4	8·8 nf.	12·6 sp.	12·0 nf.	14	6·1 nf.	9·9 sp.	14·4 nf.
5	7·8 nf.	11·6 sp.	3·2 sp.	15	8·9 sp.		5·5 sp.
6	6·7 nf.	10·6 sp.	9·5 sp.	16	7·8 sp.	11·7 nf.	11·8 sp.
7	9·5 sp.		15·7 sp.	17	6·8 sp.	10·6 nf.	3·0 nf.
8	8·5 sp.	12·3 nf.	6·9 nf.	18	9·6 nf.		9·3 nf.
9	7·4 sp.	11·3 nf.	13·2 nf.	19	8·5 nf.		0·4 sp.
10	6·4 sp.	10·2 nf.	4·3 sp.	20	7·5 nf.	11·3 sp.	6·7 nf.

About 5·9 hours before and after the times of greatest elongations Deimos will be at the distance of one diameter of the disk from the edge of the disk. The brightness of Deimos on Dec. 6 corresponds to that on Sept. 21, when it was observed by Mr. Common. If the satellites cannot be followed up till Dec. 15, it is not likely that they will be observable at the time of the next opposition in 1881.

MARS.

Mädler's spot "*a*" will pass the central meridian of the planet's disk about the following times:

		h.			h.			h.
Dec.	1	8·6	Dec.	4	10·4	Dec.	7	12·3
	2	9·2		5	11·0		8	12·9
	3	9·8		6	11·6		9	13·5 A. M.

PARTIAL ECLIPSE OF THE MOON,

Dec. 28, 1879, partly visible at Greenwich.

	h.	m.	
First contact with the penumbra, Dec. 28	1	52·3	G.M.T.
First contact with shadow	3	37·4	
Middle of the eclipse	4	26·1	
Last contact with the shadow	5	14·8	
Last contact with the penumbra	6	59·9	

Magnitude of the eclipse, 0·167.

The first contact with the shadow occurs at 164° from the northernmost point of the moon's limb towards the east.

The last contact, 147° towards the west, for direct image.

At Greenwich the moon will rise at 3h. 46m.

Book received.—Recherches sur les queues de Comètes. Th. Bredichin. Pogoste. 1879.

Erratum in November number, at line 23 from the bottom, for 9·35 read 7·35.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To August, 1879.
Lawton, W.

To Sept., 1879.
Dale, R.
Lean, W. S.
London Institution.
Ryle, Rev. Canon

To Oct., 1879.
Calver, G.
Leigh, J.

To Dec., 1879.
Potter, Rev. T.
Shawcross, W.
Ward, J. W.

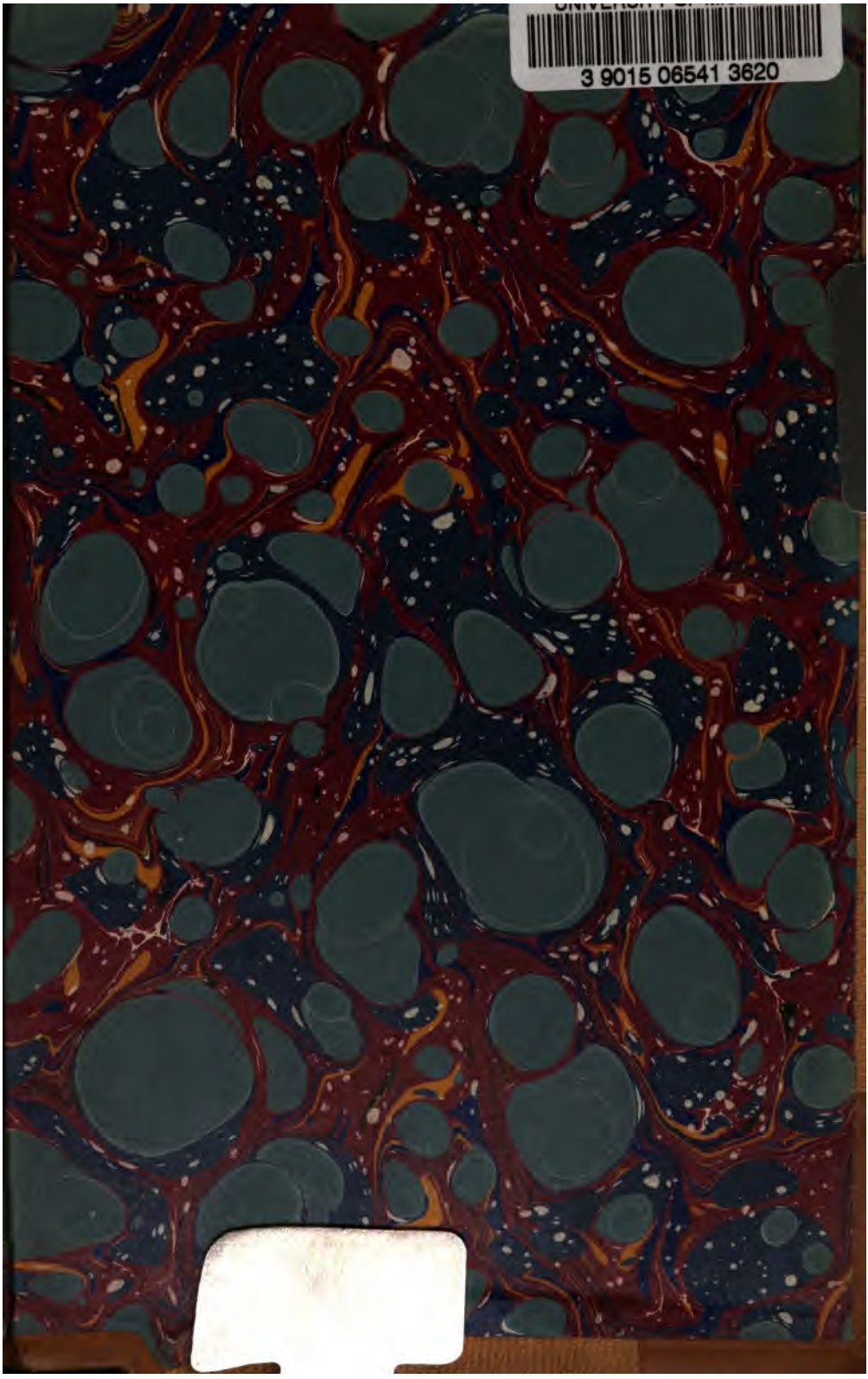
To Jan., 1880.
Burton, C. E.

To March, 1880.
Gray, J. P.

To June, 1880.
McChance, J. L.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage to all parts of Great Britain and Ireland) is fixed at **Three Shillings** per Quarter, *payable in advance*, by Penny postage stamps or otherwise. Subscribers in America may remit, either by post office order or in notes, 3½ dollars, in payment of one year's subscription, postage included.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. Jackson, 11, *Angel Court, Throgmorton Street, E.C.*, **not later than the 20th of the Month.**


3 9015 06541 3620